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Published in cooperation with the National Park Service.

JULY 1, 1958

Collection and Field Note Book

No. 59

(Oct. 17, 1960 - March 10, 1961)

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Pages

Johnston Island........................ 1-2
  Specimen collected 41374.............. 2

Kwajalein............................. 1-7, 124-125, 126-141
  Specimens collected 41374--41382...... 2-3
  " " 41420 122

Flight Kwajalein-Majuro.................... 7-8
  Majuro-Jaluit....................... 8-9
  Jaluit-Majuro.................. 121-122

Jaluit................................. 12-45, 114-120

Jabwor.................................12,16, 56,123
  Specimens collected 41383--41392 18-19

Kabbenbock............................ 13-15

Majurirek............................. 17

Enybor................................ 44-45, 56
  Specimens collected 41393-41404...... 44-45

Long.................................. 46-55

Pinlep................................ 57-65
  Specimens collected 41405--41409..... 64-65

Kinajon................................64-65, 70-79
  Specimens collected 41410--41411.. 64-65

Imruj 64-65,80-83,97
  Specimen collected 41412....... 64-65

Trip Jabwor to Imruj............. 66-69

Ligeron.......................... 84-86

Mejatto.......................... 87-96,102-113
  Specimens collected 41414--41419

Ribon............................ 98-101

Naru............................. 124

Hawaiian Islands................. 142-143
  Specimens collected 41421--41422 142-143
  " " 41429--41442 168-171
  " " 41443-41455 192-193
  Oahu.......................... 152-200

Flight Honolulu to San Francisco.... 142-143

California.......................... 144-145

Virginia
  Fairfax County.................. 146-149
  Chantilly Airport 147
  Lake Barcroft 148-149
    Specimens collected 41423-41428..148-149
  Great Falls..................... 151
  Falls Church, Seven Corners 150-151
Washington area................. 150-151

(see above)... 152-200
(Hawaii-Oahu)

UNITED STATES DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

KIPUKA PUAULU

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

HAWAII NATIONAL PARK

Self-Guiding Nature Trail

KIPUKA PUAULU

George C. Ruhle

HAWAII · NATURAL · HISTORY · ASSOCIATION

Walking Time, 1 hour

This pamphlet is a key to the numbered stakes which you will see along the trail. You may keep it if you wish, or return it to the holder at the end of the trail. It is a service to you by the HAWAII NATURAL HISTORY ASSOCIATION that you may have greater appreciation through better understanding.

Repitition is an effective tool of the learning process. As refreshers and quick reference to the descriptive paragraphs, numbers have been frequently repeated along the trail.

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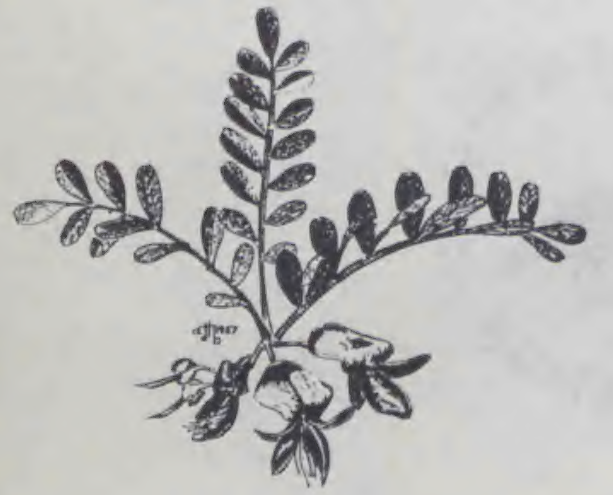
The system of 30 National Parks contains areas of highest scenic and scientific grandeur essentially in the primitive state. The National Park System, of the Department of the Interior, administers these, as well as 150 other areas of outstanding national significance. The law of the land enjoins that these be so used that they may be passed unimpaired for the enjoyment of future generations.

The story of HAWAII NATIONAL PARK is the story of active volcanism distinguished by eruptions of very fluent lava. The park is in two sections: that on the island of Hawaii embraces the summit of Mauna Loa and most of Kilauea Volcano; the section on the island of Maui includes the great crater of Haleakala.

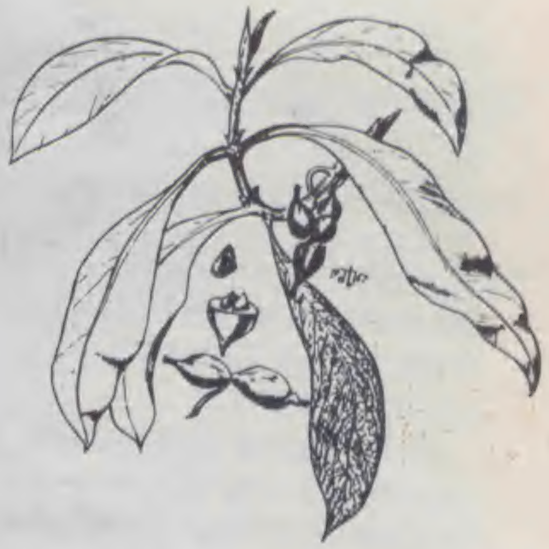
In the maze of lava streams that pour out during Hawaiian eruptions, areas of older surface often escape cover by successive flows. An oasis thus formed is called a *kipuka*, a word that also means a loop or an open space in the forest. If a kipuka of large size is effectively isolated for a long period of time, good, deep soil forms, the plant inhabitants develop characteristics that reflect the nature of their history and environment, a distinctive flora is evolved. Such is the *Kipuka Puaulu* with its area of 100 acres. Some forty-odd species of native trees have been claimed as natural members of its flora. Many type specimens have been collected in it and described by botanists. Authorities have been drawn from faraway countries to observe its treasures. It is a significant place in the world of plants.

The name has been interpreted variously. *Pua* means flower, but is also to be translated as a collection of things bound together. *Ulu* is to grow; it is also the name for breadfruit, which appears inapplicable here. A popular nickname, Bird Park, has no significance and little to commend it.



Mamane
See No. 8

Pilo
See No. 13

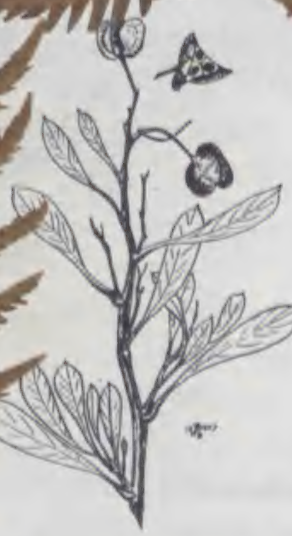


To label a plant or natural specimen is too often prelude to its destruction or removal. Please respect the integrity of specimens and be thoughtful of those who follow you.

Cigarette butts and trash do not add to your enjoyment of the park. You can easily dispose of them so that they cannot be obnoxious to you and to those who come after you.

At the start of the trail is an exhibit with a map showing the outlines of the *kipuka*, surrounded by prehistoric but recent (before 1800) flows. Four common native birds, the *apapane*, *iiwi*, *amakihi*, and *elepaio*, are illustrated in color. This is a favorite haunt, giving the nickname *Bird Park*. Since the birds forage in the lofty canopy of trees, and sing little during the heat of the day, patience [illegible] are necessary qualities for see[illegible] studying these alluring subjects.

[illegible] *odonaea sp.)*, one of the [illegible] sh[illegible] be seen along roads and [illegible]rk. It grows to the [illegible] along the Mauna Loa [illegible] male flowers [illegible] The clusters [illegible] capsules [illegible] showy [illegible] for leis [illegible] dye [illegible] ther [illegible] ood of [illegible] useful [illegible]



Aalii with capsules

Dodonaeas are found on all of the larger islands of Hawaii. The three chief species are *D. viscosa*, *D. eriocarpa*, and *D. sandwicensis*. *D. viscosa* is also found in other parts of the Pacific.

2. Ohia Lehua *(Metrosideros collina)*. The *ohia*, like the eucalyptus and guava, belongs to the Myrtle Family. It is found throughout Polynesia, and grows from sea-level to 9,000 feet in Hawaii. It is the commonest forest tree on the islands often growing in almost pure stands. It is a pioneer on most lava flows. The showy pompoms of bright red stamens make it attractive while in flower.

3. As you stand on this rise, look about you. You are on the threshold of Kipuka Puaulu. Note the contrasting scenes behind and before you. Almost all of the trees on the flows back of you are ohia; the shrubs mixed through them are *pukiawe (Styphelia tameiameiae)* and *aalii*.

4. Ionui *(Dryopteris paleacea)*. A rather stiff, erect fern that is common in Bird Park. Varieties or close relatives of this fern are widespread throughout the world. This and several other ferns are erroneously termed *laukahi*, the Hawaiian word for plantain, *Plantago major*.

5. Palapalai *(Microlepia setosa)*, a lacy, attractive fern, one of the commonest along the trail. It prefers open glades and edges of the woods. It grows on all of the larger islands, and elsewhere on Pacific Islands, Malaysia, India, and Ceylon. It was used to decorate the altars of Laka, goddess of the hula.

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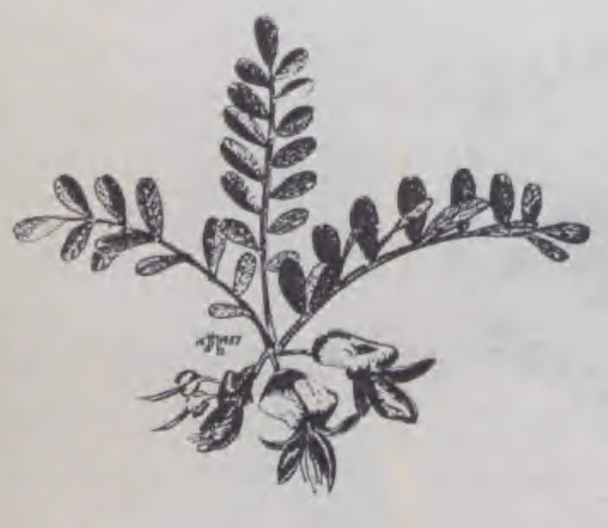
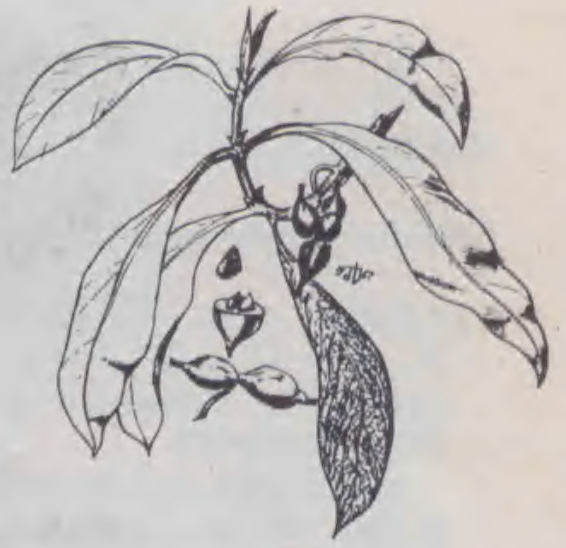


Mamane
See No. 8

Pilo
See No. 13



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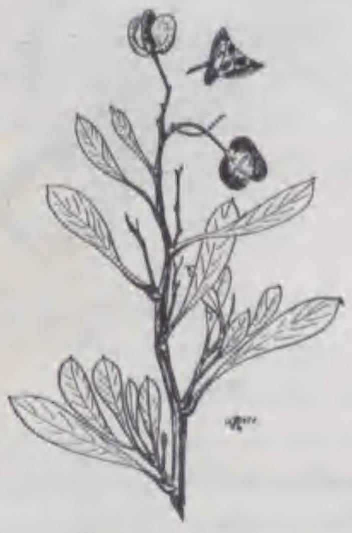
1. Aalii *(Dodonaea sp.)*, one of the commonest shrubs to be seen along roads and trails in the park. It grows to the size of a small tree along the Mauna Loa Truck Trail. Male and female flowers appear on separate plants. The clusters of yellow or bright red seed capsules with papery wings make the shrub showy while in fruit. These were used for leis and for extracting a brilliant red dye with boiling water. *Kapa* and other things were colored with it. The wood of the plant is tough and durable, useful for spears and various purposes.



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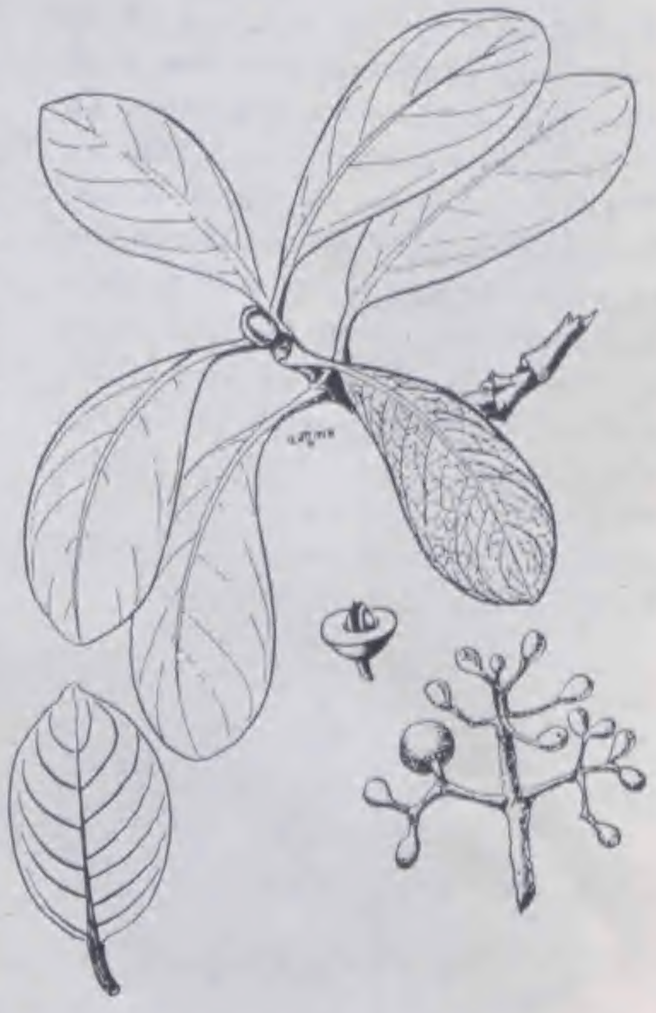
6. Sword Fern, Nianiau or **Okupukupu** *(Nephrolepis exaltata)*. Several species exist in the park. Native to tropical and subtropical climes, the sword fern is a popular house plant that exhibits many varieties. This is a pioneer plant in new lava fields and on the floor of Kilauea Crater. A very hairy variety, *N. hirsutula*, grows abundantly in steam cracks.

7. The common herbs forming a ground cover here are an introduced geranium (7A) and the native strawberry (7B), *ohelo papa (Fragaria chiloensis)*. The latter bears fruits that are small, white, and often of good flavor. This strawberry is distributed from southern Chile to the Aleutians.

The vigorous grove contains *papala kepau, kopiko, pilo, olopua, kolea, mamane, mamaki, manele* and *ohia lehua* trees. These are discussed individually along the trail.

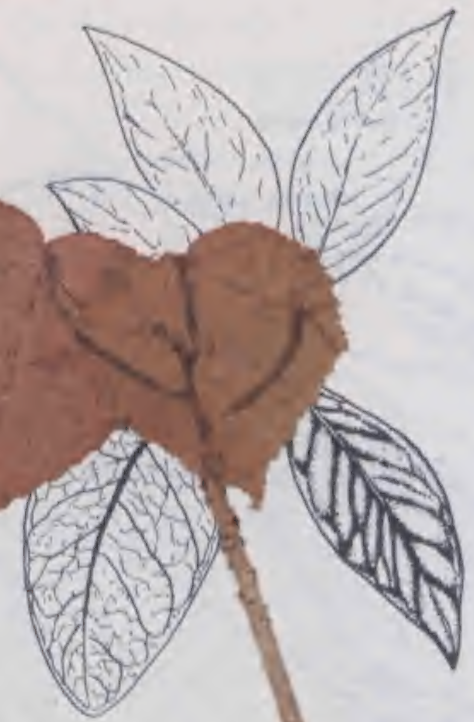
8. Mamane *(Sophora chrysophylla)*. A common shrub or small tree found from 2,000 - 10,000 feet on all islands except Molokai, this member of the bean family bears attractive yellow flowers and compound leaves. It is re-related to the golden shower trees. It is eagerly eaten by livestock and feral goats, that have eradicated it in many areas. The wood is very hard and durable. Note the winged pods and shiny orange or yellow seeds, if the trees are in fruit. The *mamane* is endemic to the Hawaiian Islands, but other species of the genus, more than two dozen in number, are found distributed throughout warmer regions of the world.

9. Kopiko *(Straussia Hillebrandii)* is an abundant tree in Bird Park. It belongs to the important Coffee Family, which is widespread, is mostly tropical, and has 350 genera, of which a dozen are native to the Hawaiian Islands. Of these, *Straussia, Gouldia,* and *Bobea* are endemic. *Kopiko* in Bird Park are readily identified by their dark green, opposite leaves that have conspicuous midribs and veins. A scaly aphid often infests the lower surface of the leaves.



Kopiko

10. Hawaiian olive, Olopua *(Osmanthus sandwicensis)*. The glossy, leathery leaves may be six inches long on very young trees. The hard, dense wood was used for handles of spears and adzes. *Osmanthus* belongs to the same family as the cultivated olive, *Olea europea.*



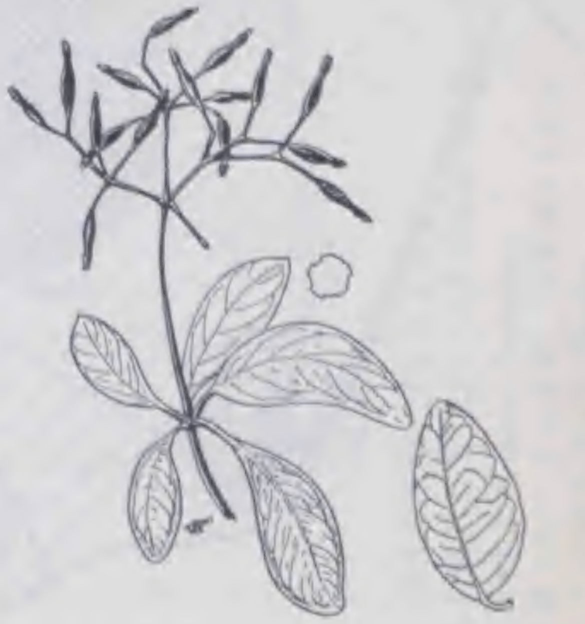
Olopua

11. Soapberry, Manele *(Sapindus [illegible]aponaria)*. It is remarkable that this [illegible] tree appears to be identical with [illegible] evergreen soapberry of tropical [illegible]ca. Here the leaves become yellow[illegible] in autumn and are shed in winter. The smooth gray bark on larger trees peels off in big flakes. The leaves are compound with four to six pairs of leaflets; on young plants they often grow on winged rachises, [illegible], flattened stemlets. The pulpy seed coverings contain saponnin, which lathers in water. The hard, round, brownish-black seeds are sought by Hawaiians for bead leis.

12. Papala kepau *(Pisonia inermis)*. The shiny, oblong leaves are dark and glossy. Like those of many other Hawaiian trees, they may be very large on young trees. The fruits, borne in a loose, open panicle 6 to 12 inches long, exude a viscid glue, used by the early Hawaiians for catching perching birds to obtain feathers for feather cloaks and ornaments. The word *kepau* means a viscous liquid like tar or molasses.

13. Pilo *(Coprosma rhyncocarpa)*. Of the half hundred species in this genus, fifteen have been described from the Hawaiian Islands. Several species occur as trees and shrubs in the park; of these sprawling *kukaenene*, so common on barren lava fields and open forest, is best known. A member of the Coffee Family, little use appears to have been made of these small trees. The *pilo* is readily recognized by its opposite leaves with broad triangular stipules between their stems forming a loose, funnel-shaped sheath.

14. Bracken, Kilau *(Pteridium aquilinum)*. The cosmopolitan bracken, possibly the best-known fern, grows abundantly in open grassland. The native form is found from elevations of 500 to 9,500 feet. The plant has a creeping, underground stem upon which the large, coarse, triangular fronds grow. Varied use is made of the plant throughout the world such as for food, medicine, litter, and basket material. The fruiting bodies of bracken occur in a continuous band along the edges of a frond, which are partially rolled back over it.



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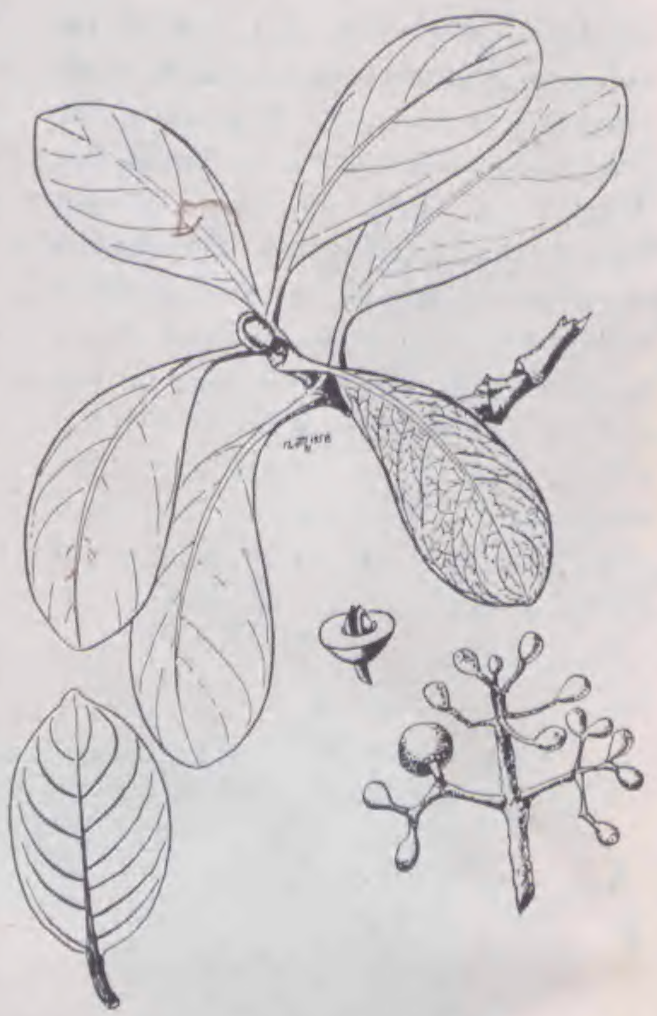

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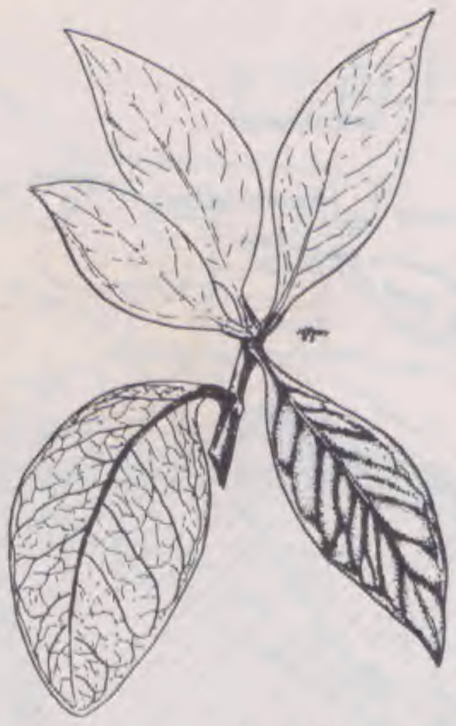

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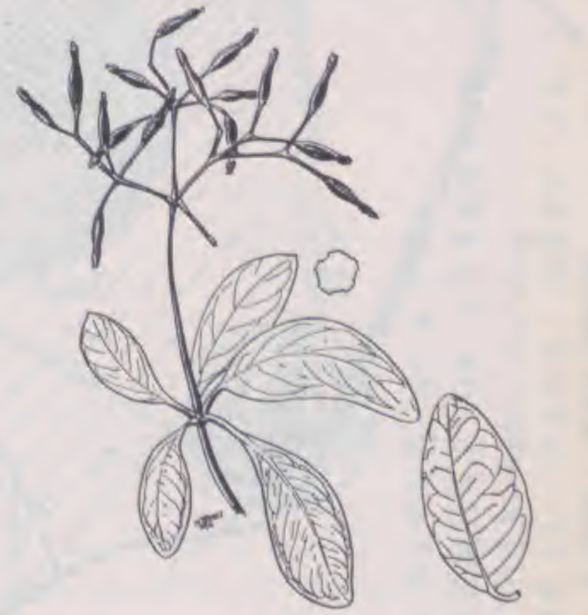
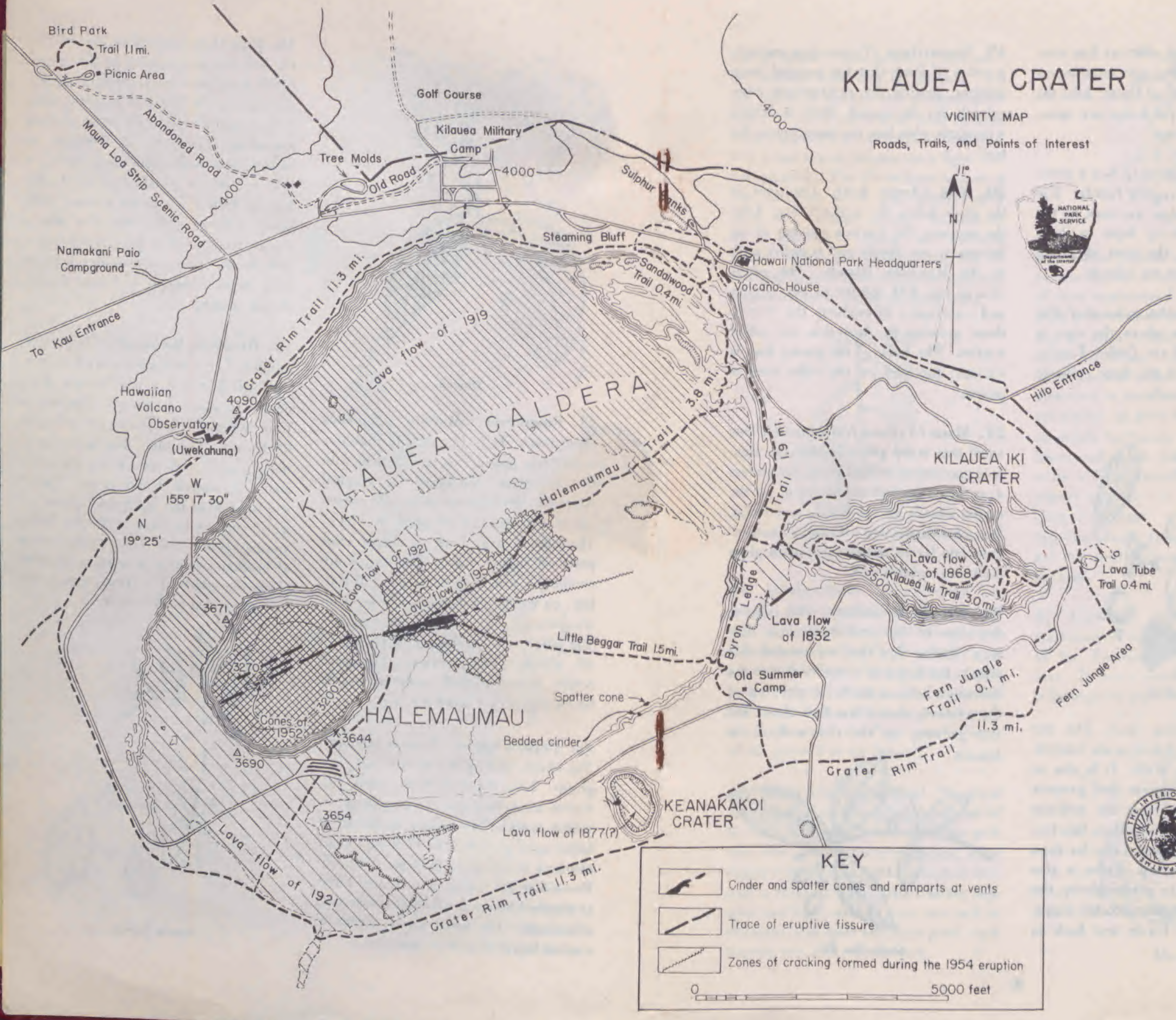


Papala kepau



KILAUEA CRATER

VICINITY MAP

Roads, Trails, and Points of Interest

Bird Park
Trail 1.1 mi.
Picnic Area
Abandoned Road
Mauna Loa Strip Scenic Road
4000
Tree Molds
Old Road
Golf Course
Kilauea Military Camp
4000
Sulphur Banks
Steaming Bluff
Namakani Paio Campground
To Kau Entrance
Crater Rim Trail 11.3 mi.
Sandalwood Trail 0.4 mi.
Hawaii National Park Headquarters
Volcano House
Hilo Entrance
Lava flow of 1919
KILAUEA CALDERA
Hawaiian Volcano Observatory
(Uwekahuna)
4090
W 155° 17' 30"
N 19° 25'
Halemaumau Trail 3.8 mi.
Trail 1.9 mi.
KILAUEA IKI CRATER
Lava flow of 1868
Kilauea Iki Trail 3.0 mi.
3500
Lava Tube Trail 0.4 mi.
Lava flow of 1921
Lava flow of 1954
3671
3270
3200
Cones of 1952
HALEMAUMAU
3644
3690
Little Beggar Trail 1.5 mi.
Byron Ledge
Lava flow of 1832
Old Summer Camp
Fern Jungle Trail 0.1 mi.
Fern Jungle Area
Spatter cone
Bedded cinder
11.3 mi.
Crater Rim Trail
KEANAKAKOI CRATER
Lava flow of 1877(?)
3654
Lava flow of 1921
Crater Rim Trail 11.3 mi.
KEY
Cinder and spatter cones and ramparts at vents
Trace of eruptive fissure
Zones of cracking formed during the 1954 eruption
0
5000 feet
N
NATIONAL PARK SERVICE
Department of the Interior

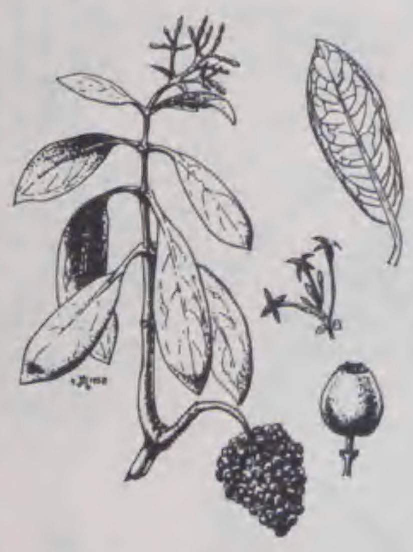
The *Park Museum* is in the Park Administration Building on the main highway, one mile inside the Hilo Entrance to the Park. It is open from 7:30 a.m. to 4:30 p.m. daily, and is dedicated to the wonders of the park story. Motion pictures of eruptions of Mauna Loa and Kilauea are shown daily in the Park Auditorium in the same building at 9:30 a.m. and 1:15 and 1:45 p.m. Admission is free. Information is dispensed at the counter in the lobby of the Administration Building; maps, copies of motion pictures and kodaslides, and literature are on sale at this place by the Association. All profits are used for furthering interpretive efforts of the park.

UNITED STATES
DEPARTMENT OF INTERIOR
Fred A. Seaton, *Secretary*
NATIONAL PARK SERVICE
Conrad L. Wirth, *Director*

15. Manena *(Pelea cinerea)* has slender, twining branchlets with small leaves and comparatively small fruits. Like the others of its genus, the leaves are opposite; some are fragrant.

16. Mamaki *(Pipturus sp.)*, is a member of the stinging nettle family. The inner bark of this plant was used by the Hawaiians for making *kapa* or bark cloth. It is one of the most abundant fiber plants found in the Islands.

17. Manono *(Gouldia terminalis)*. The lone tree ten paces above the sign is another member of the Coffee Family. The genus is one of the three endemic to the Hawaiian Islands.



Manono

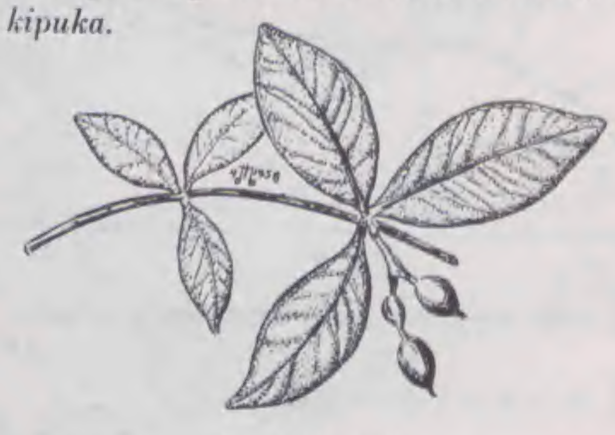
18. Kolea *(Myrsine sp.)*. The red color of the young leaves is an interesting feature of this plant. It is due to the chemical anthocyanin that protects new, tender leaflets from the brilliant sun of the tropics. Wood from this tree was used for houseposts; a dye for *kapa* was made from the sap. *Kolea* is also the name given to the golden plover, the bird that completes a remarkable migration to the Arctic Circle and back to Hawaii each year.

19. Nasturtium *(Tropaeolum majus)*, a native of Peru, that has escaped from gardens, finding the environment very suitable for its spread. Here it drapes a prostrate *ohia* log, ten paces below the trail.

20. Koa *(Acacia koa)*. The trees in the glade below the trail are *koa*. Like the *mamane*, the *koa* is a member of the legume or pea family and is native only to the Hawaiian Islands. The genus *Acacia* has 450 species in the tropics and subtropics throughout the world; those growing in Australia, are called wattles. The bark of the young *koa* is smooth; the bark on the older trees is coarse.

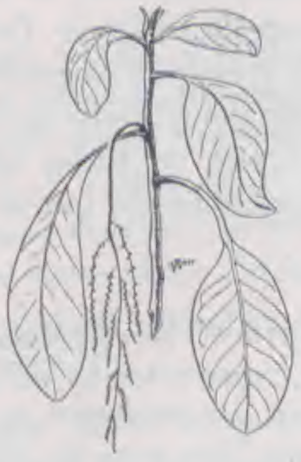
21. Maua *(Xylosma Hillebrandii)*. This small tree is ten paces behind the sign. It is uncommon in Bird Park, but prefers drier lands on leeward slopes of all the major islands except Kauai and Oahu. It is a handsome tree with shiny, toothed, crenulate leaves whose color often gives the tree a reddish cast.

22. Kipuka Boundary. This ridge is the edge of the prehistoric lava flow from Mauna Loa that surrounded this *kipuka* but failed to cover it. Notice the difference between the forest growing on the relatively recent lava flow ahead and that growing on the rich soil of the *kipuka*.



Maile No. 36

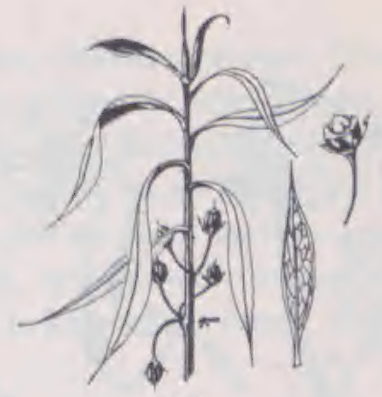
23. Papala *(Charpentiera obovata)*, an endemic tree, rare in the park. Do not touch or disturb this planted specimen. Its small red flowers hang in large loose panicles from the ends of branches. The wood is soft, fibrous, very light, and inflammable. The Hawaiians heaped it into bonfires which they pushed over cliffs and vantage points. Because of their buoyancy, rising air currents would buffet the glowing torches in brilliant display upward, downward, and sideways like so many shooting stars.



Papala

24. Alaalawainui *(Peperomia reflexa)*. A large number of species of this widespread genus of the Pepper Family grow in Hawaii. Condiment pepper is made from *Piper nigrum*, native to the Oriental tropics. The celebrated Polynesian drink, *awa* or *kava*, was made from the root of *Piper methysticum* which grows 6 to 12 feet tall.

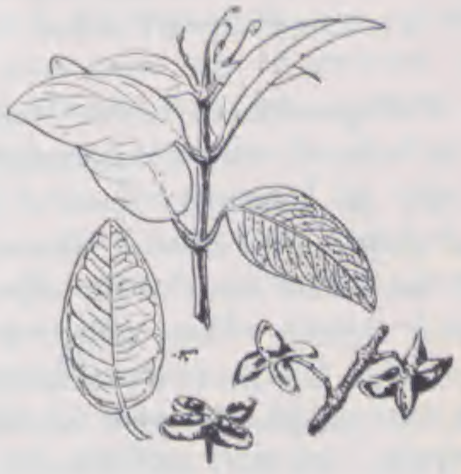
25. Alani *(Pelea volcanica)*. The great botanist, Asa Gray, named this genus of the Rue (Citrus) Family after the goddess Pele. The leaves are opposite, often notched at the apex. When crushed they emit a fragrant odor. The fruiting capsules are large, usually over one inch in diameter, and open into four parts, each bearing two shiny black seeds.



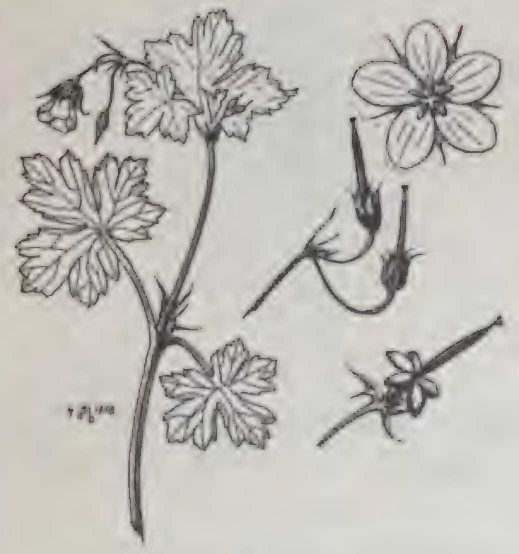
Naio

26. False Sandalwood, Naio *(Myoporum sandwicense)*. When the supply of true sandalwood *(Santalum* sp.), a chief item of trade in the early days, began to run low, *naio* was used as an inferior substitute. Since demand for it never became great, *naio* trees are still abundant in these islands, to which they are native. In Bird Park old trees develop deeply furrowed, knobby boles, with heartwood much decayed so that only strips of living tissue remain. (See illustration on page 12). Despite this, they cling tenaciously to life, sending out vigorous shoots from their tops. These are the most picturesque objects along the trail.

27. Tarweed, Pukamole *(Lythrum maritimum)*. A sticky, hairy undershrub of the American tropics grows rank here. It bears small, magenta flowers. It belongs to the Crape Myrtle Family.



Alani



Geranium

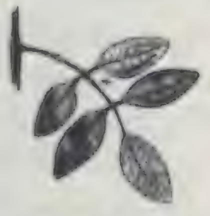
28. Open Forest Growth. In this locale, the trees do not compete with each other in their efforts to obtain sunlight. Compare the symmetry of the spreading ohia in the distance to the crowded *koa* on the left skyline. Note also the fallen *ohia* twenty paces to the left. Its branches have turned upward and in time may become independent trees as the old tree decays. Curiously shaped *ohia* may be seen on the right of the trail beyond sign 39, and on the left of the trail 30 paces before reaching sign 42. Similar contorted individuals are especially conspicuous at Kipuka Nene campground.

This is an excellent spot for observing birds. The frequent crowing of pheasant cocks is a complementary sound.

29. Collapsed Lava Tube. Many layers of volcanic ash have accumulated through the centuries, some of them from eruptions of distant Mauna Kea. Such ash forms much of the topsoil in Kipuka Puaulu. This collapsed lava tube and the lava above it provide opportunity for gauging the depth of the soil. DANGER—DO NOT APPROACH THE TUBE.

30. Kookoolau *(Bidens pilosa)*, an introduced weed from tropical America. Its annoying, black needles, less than one-half inch long, are pronged so that they readily cling to clothes and to fur of animals. The many species of *Bidens* have been given appropriate popular names: Spanish needles, beggar ticks, sticktights, tick seed, bur marigolds. Over sixty blander native Hawaiian species have been described. Leaves and tips of young plants, fresh or dried, are steeped for a beverage, often in preference to commercial tea. In season, a large undershrub native to Puuwaawaa glitters with thousands of golden flowers in big panicles, a glorious sight indeed. Kokoolau Crater on Chain of Craters Road was named for the species growing within it.

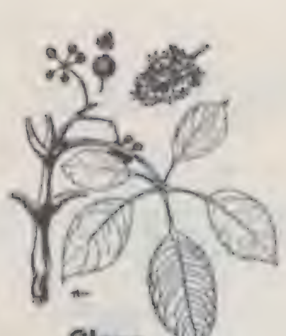
31. Ae *(Zanthoxylum dipetalum)*. The *Zanthoxyla*, represented by three species in Bird Park, are very rare in numbers of individuals. This is an unusually large specimen. Like the *Pelea*, this belongs to the Rue (Citrus) Family.



Ae leaf

32. Akala *(Rubus hawaiiensis)*, a giant among raspberries. A half dozen berries fill a bowl. The bearing season, which is in midyear, like the taste and color of the fruit, varies with plants and location. Usually the berries are purple, but the blossoms and juice are pink. *Akala* means *pink* in Hawaiian.

A short trail to the left leads to a huge *koa* whose base is seven feet in diameter.



Olapa

33. Huehue *(Cocculus ferrandianus)*, a native climber widely distributed from sea coast to 5,000 feet. The tough flexible stems are useful as natural twine. Hawaiians wove them into baskets with funnelform mouths that were used as fish traps.

34. Alani *(Pelea Zahlbruckneri)*. Named by the great Hawaiian dendrologist, Joseph Rock, for his celebrated friend, Dr. A. Zahlbruckner, Director of the Viennese Botanical Museum. It has the largest leaves of any *Pelea*, and large, curious fruiting capsules like four-pointed stars.

35. Olapa *(Cheirodendron Guadichaudii)*. One of the commonest, most conspicuous of forest trees. Its bright green, shiny leaves are palmately compound and constantly flutter in the breeze. When bruised, all parts of the tree emit a strong turpentine odor. The name *olapa* was applied to those hula dancers with lithe, supple bodies and most graceful motions, who could best imitate the dancing of the *olapa* leaves. The tree is twenty paces behind this sign, growing in the big patch of *Microlepia*.

36. Maile *(Alyxia olivaeformis)*. This twining, native, vinelike shrub is the laurel of old Hawaii. Its fragrant stems and shiny leaves carry a faint odor of vanilla. They were a favorite and an indispensable adjunct to every festive occasion, being used for decoration and for leis.

37. Mint *(Mentha spicata)*. This large patch of non-native mint affords an example of how native plants are often crowded out by hardy foreigners. Please do not pick the mint and drop it along the trail, as this aids in spreading it and in choking out desirable plants.

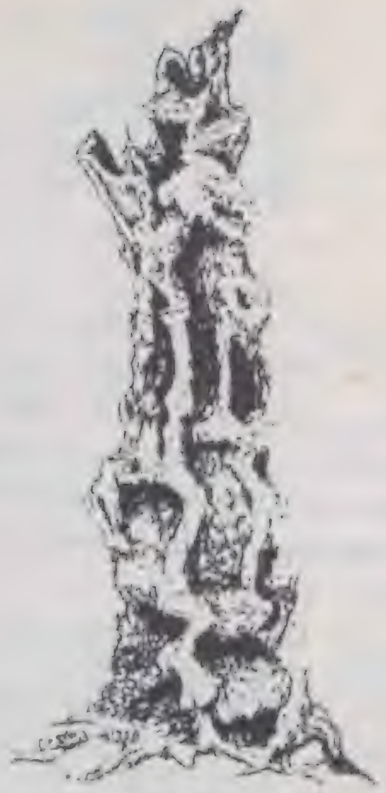
38. Large Koa *(Acacia koa)*. In regions in which growing seasons are indefinite, the age of a tree cannot readily be determined by a count of annular rings. This tree is probably several hundred years old. The koa was used more than any other tree in making Hawaiian canoes, both the single *kaukahi* and the double *kaulua*. The hard, beautiful wood is suitable for the manufacture of furniture and other objects, such as bowls and trays.

39. Opuhe *(Urera sandwicensis)*, like the *mamaki*, is a member of the stinging nettle family and is used for making *kapa*. It is a medium-sized tree with male and female flowers growing on separate plants. The large, oblong, dark green leaves have prominent veins; the stems exude a watery, milky fluid when broken. Fibers from the bark are tough, useful for making cord for fish nets.

40. Large Ohia Lehua *(Metrosideros collina)*. An idea of the size to which these trees grow may be obtained from this specimen. It is approximately 80 feet high, and about five feet in diameter at the base. The flower of the *ohia*, the *lehua*, is the flower of the Island of Hawaii. Many birds, particularly the red *apapane*, feed on the nectar of these flowers. The wood of *ohia* is hard and durable; it was used for making gunwales of outrigger canoes, timbers for housing, and poi boards.

41. Ti, Ki *(Cordyline terminalis)*, is a very useful plant to Hawaiians. The leaves are used in wrapping food, either for storage, for handling, or for cooking in the earth. They formerly served for thatch and for skirt material. A crude musical instrument is made by rolling up a leaf. *Okolehao*, a potent alcoholic beverage, is brewed from the roots of this plant.

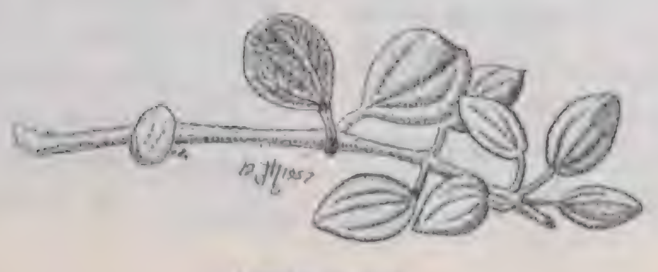
42. Young Koa Leaves *(Acacia koa)*. Both the fernlike, juvenile leaves and the adult, sickle-shaped phyllodea may be seen on the lower branches of these trees. A young *koa* starts growth with compound leaves only. As it grows, the petioles (leaf-stalks) expand and replace the leaflets. The resulting leaflike organ, termed a *phyllode*, may be a clue to the evolutionary history of the *koa*. Finely divided leaves are characteristic of plants that are not exposed to loss of life-sustaining moisture through surface evaporation. A leathery, smaller-surfaced appendage is better adapted to withstand the strain of drought. Despite heavy rainfall in the islands, supplies of moisture stop abruptly with a shift of winds: the soil and atmosphere quickly assume a desert character which, if of long duration, is critical to poorly adjusted plants. The *koa* has become neatly adjusted to its environment.



Naio trunk

43. Grassland. Many grasses not native to the island grow in Kipuka Puaulu. Most of these were introduced with stock feed brought from the mainland. In some areas the grasses are growing so densely that it is impossible for native plants to get a start.

44. Avocado *(Persea americana)*. Somebody thoughtlessly tossed aside a seed. Well above optimum range for the plant, it has grown into a robust tree that cannot bear fruit.

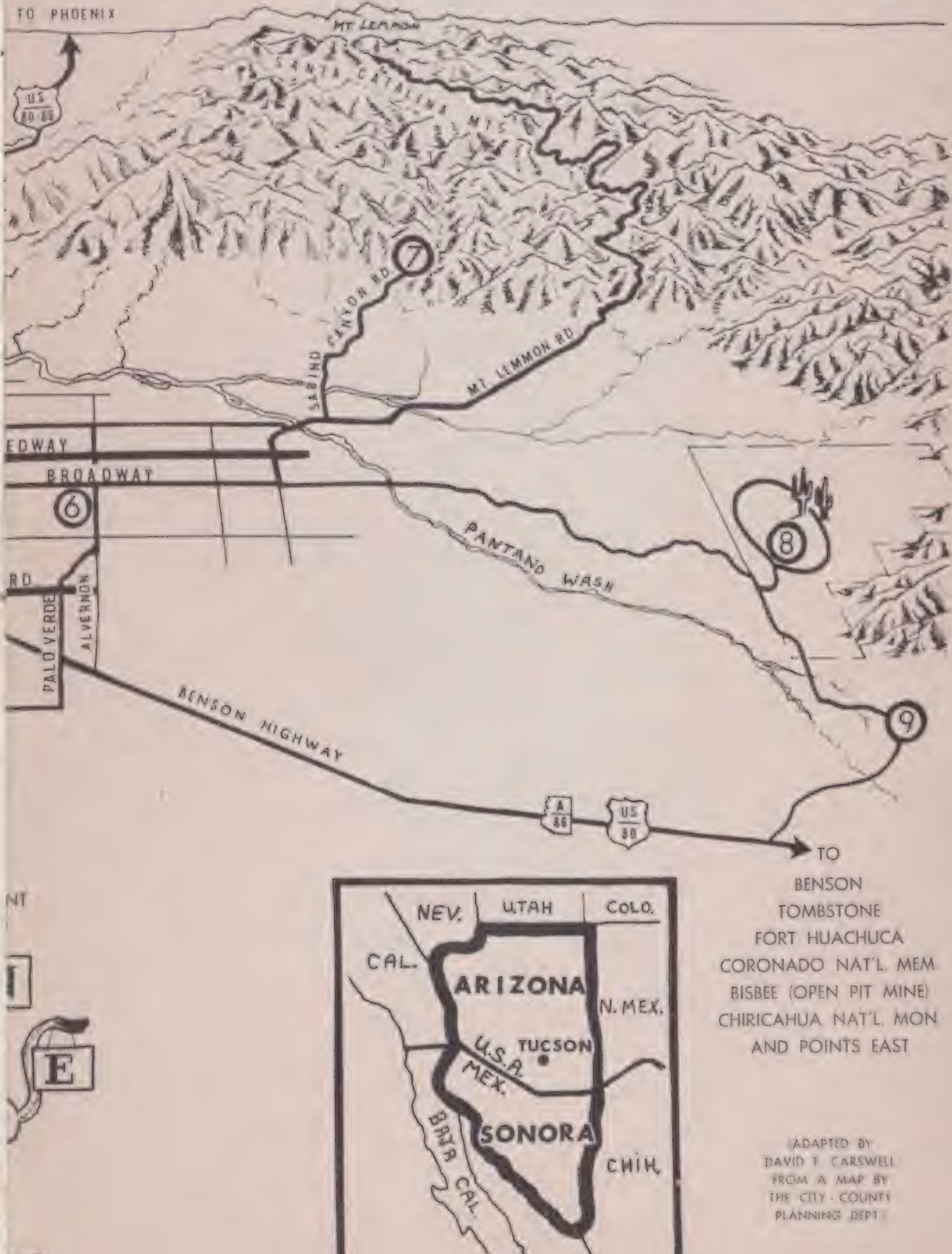


Alaalawainui

DESERT MUSEUM

l Tucson Area

AT THE DESERT MUSEUM
one admission charge
covers all exhibits:
Adults — 75c
Children 6 to 12 — 25c
Under Six — Free


TO PHOENIX
MT. LEMMON
SANTA CATALINA MTS
US 80-89
7
SABINO CANYON RD
MT LEMMON RD
EDWAY
BROADWAY
6
RD
PALO VERDE
ALVERNON
PANTANO WASH
8
BENSON HIGHWAY
A 86
US 80
9
TO
BENSON
TOMBSTONE
FORT HUACHUCA
CORONADO NAT'L. MEM
BISBEE (OPEN PIT MINE)
CHIRICAHUA NAT'L. MON
AND POINTS EAST
NEV.
UTAH
COLO.
CAL.
ARIZONA
N. MEX.
TUCSON
U.S.A.
MEX.
SONORA
BAJA CAL.
CHIH.

(ADAPTED BY
DAVID F. CARSWELL
FROM A MAP BY
THE CITY - COUNTY
PLANNING DEPT.)

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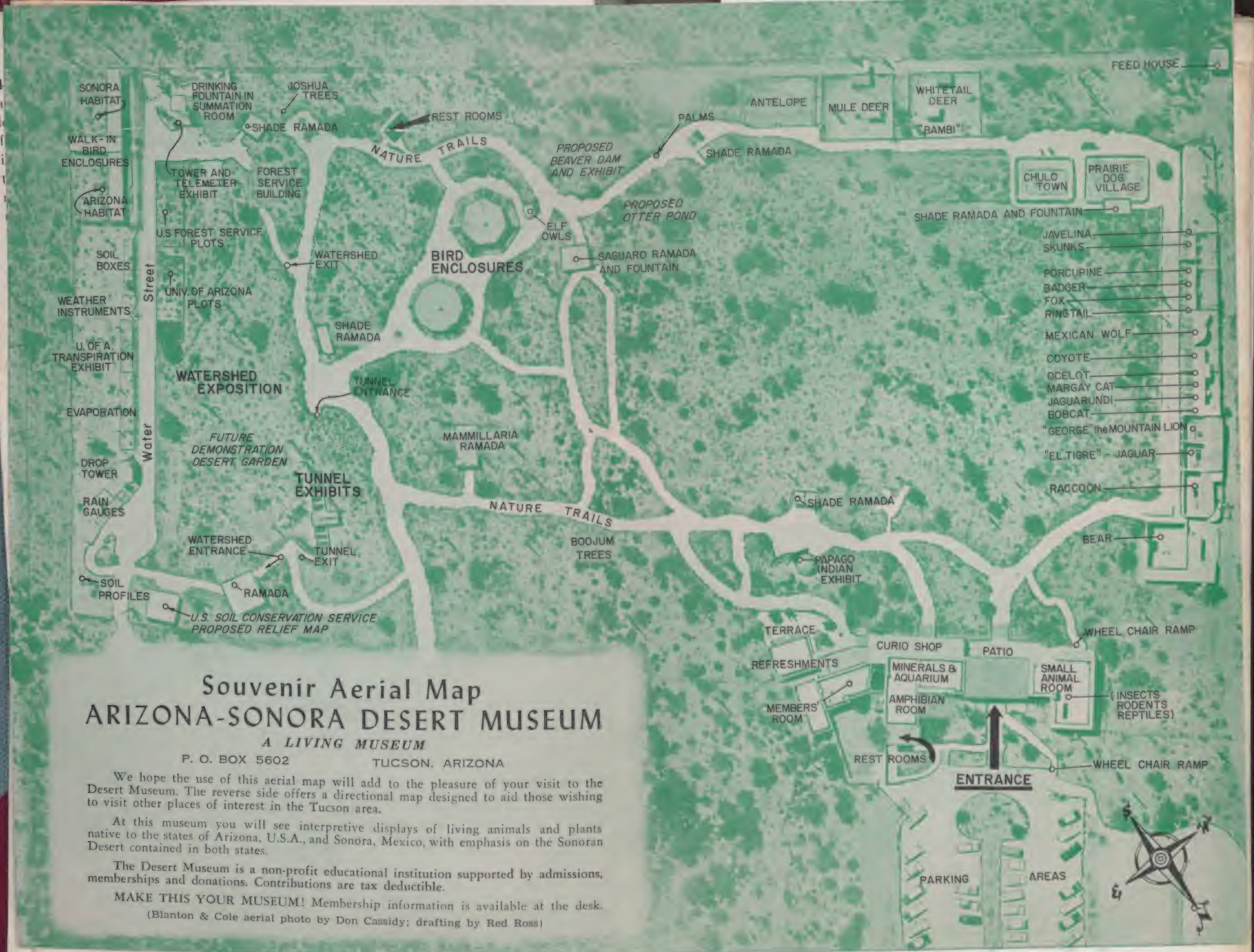
SONORA HABITAT
WALK-IN BIRD ENCLOSURES
ARIZONA HABITAT
SOIL BOXES
WEATHER INSTRUMENTS
U. OF A. TRANSPIRATION EXHIBIT
EVAPORATION
DROP TOWER
RAIN GAUGES
SOIL PROFILES
Water Street
DRINKING FOUNTAIN IN SUMMATION ROOM
JOSHUA TREES
SHADE RAMADA
REST ROOMS
TOWER AND TELEMETER EXHIBIT
FOREST SERVICE BUILDING
U.S FOREST SERVICE PLOTS
UNIV. OF ARIZONA PLOTS
WATERSHED EXIT
WATERSHED EXPOSITION
FUTURE DEMONSTRATION DESERT GARDEN
TUNNEL ENTRANCE
TUNNEL EXHIBITS
WATERSHED ENTRANCE
TUNNEL EXIT
RAMADA
U.S. SOIL CONSERVATION SERVICE PROPOSED RELIEF MAP
NATURE TRAILS
BIRD ENCLOSURES
SHADE RAMADA
ELF OWLS
PROPOSED BEAVER DAM AND EXHIBIT
PROPOSED OTTER POND
SAGUARO RAMADA AND FOUNTAIN
MAMMILLARIA RAMADA
NATURE TRAILS
BOOJUM TREES
PALMS
SHADE RAMADA
ANTELOPE
MULE DEER
WHITETAIL DEER
"BAMBI"
FEED HOUSE
CHULO TOWN
PRAIRIE DOG VILLAGE
SHADE RAMADA AND FOUNTAIN
JAVELINA
SKUNKS
PORCUPINE
BADGER
FOX
RINGTAIL
MEXICAN WOLF
COYOTE
OCELOT
MARGAY CAT
JAGUARUNDI
BOBCAT
"GEORGE" the MOUNTAIN LION
"EL TIGRE" - JAGUAR
RACCOON
BEAR
SHADE RAMADA
PAPAGO INDIAN EXHIBIT
WHEEL CHAIR RAMP
TERRACE
REFRESHMENTS
CURIO SHOP
PATIO
MINERALS & AQUARIUM
AMPHIBIAN ROOM
SMALL ANIMAL ROOM
(INSECTS RODENTS REPTILES)
MEMBERS' ROOM
REST ROOMS
ENTRANCE
WHEEL CHAIR RAMP
PARKING AREAS
S
W
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Souvenir Aerial Map

ARIZONA-SONORA DESERT MUSEUM

A LIVING MUSEUM

P. O. BOX 5602 TUCSON, ARIZONA

We hope the use of this aerial map will add to the pleasure of your visit to the Desert Museum. The reverse side offers a directional map designed to aid those wishing to visit other places of interest in the Tucson area.

At this museum you will see interpretive displays of living animals and plants native to the states of Arizona, U.S.A., and Sonora, Mexico, with emphasis on the Sonoran Desert contained in both states.

The Desert Museum is a non-profit educational institution supported by admissions, memberships and donations. Contributions are tax deductible.

MAKE THIS YOUR MUSEUM! Membership information is available at the desk.

(Blanton & Cole aerial photo by Don Cassidy; drafting by Red Ross)

N.C. U.S.A.

THE DESERT MUSEUM IS
open every day of the year —
from 10 A.M. to 5 P.M.
(until sundown on Sundays
and holidays).

ARIZONA-SONORA DESERT MUSEUM

Guide Map of Tucson Area

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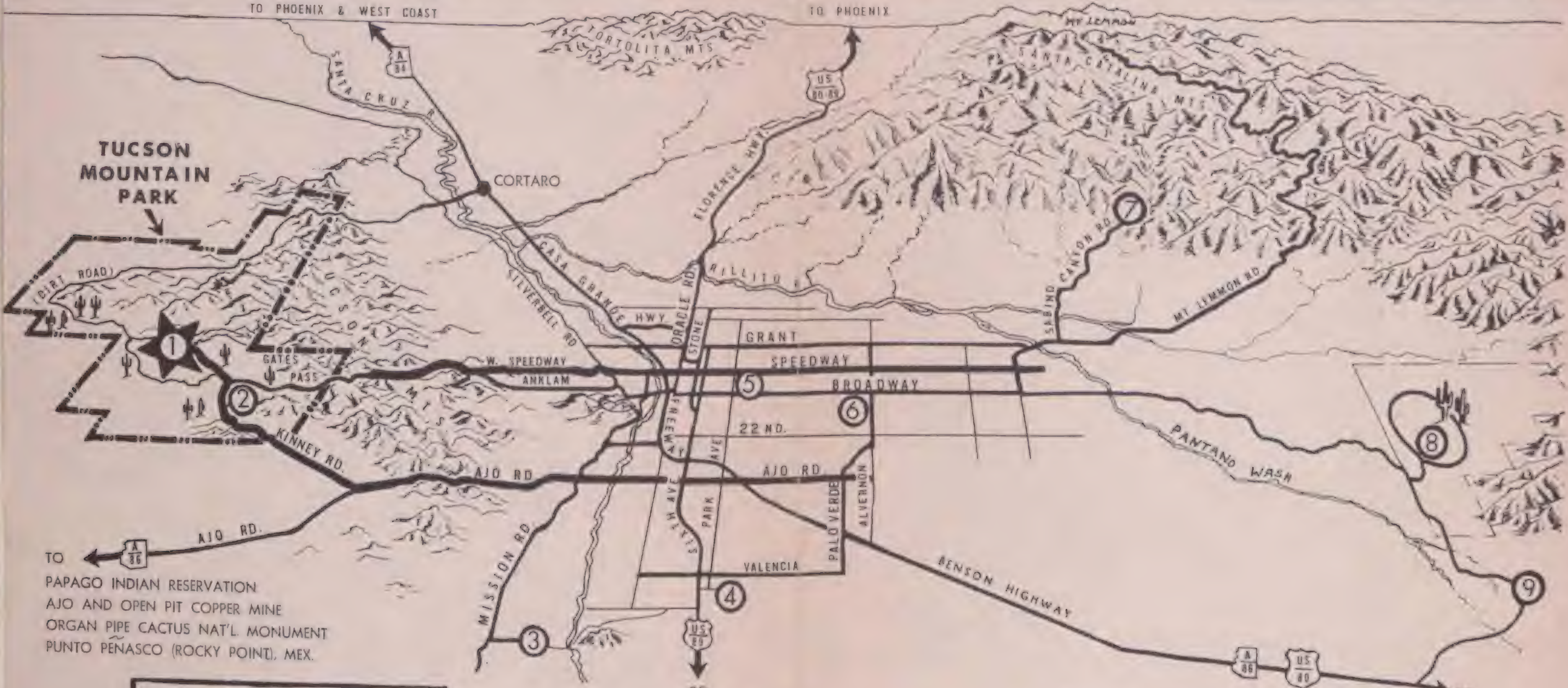
TO PHOENIX & WEST COAST
A 84
TO PHOENIX
US 80-89
TORTOLITA MTS
MT LEMMON
SANTA CATALINA MTS
SANTA CRUZ R
TUCSON MOUNTAIN PARK
CORTARO
FLORENCE HWY
CASA GRANDE HWY
SILVERBELL RD
RILLITO R
ORACLE RD
STONE
SABINO CANYON RD
MT LEMMON RD
(DIRT ROAD)
TUCSON MTS
GATES PASS
W. SPEEDWAY
ANKLAM
GRANT
SPEEDWAY
BROADWAY
22 ND.
KINNEY RD.
AJO RD
AJO RD
FREEWAY
6TH AVE
PARK AVE
PARK
PALO VERDE
ALVERNON
PANTANO WASH
VALENCIA
MISSION RD
BENSON HIGHWAY
AJO RD.
A 86
US 89
A 86
US 80
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TO
PAPAGO INDIAN RESERVATION
AJO AND OPEN PIT COPPER MINE
ORGAN PIPE CACTUS NAT'L. MONUMENT
PUNTO PEÑASCO (ROCKY POINT), MEX.

TO
TUBAC PRESIDIO HIST. MON.
TUMACACORI NAT'L. MONUMENT
NOGALES AND OLD MEXICO

TO
BENSON
TOMBSTONE
FORT HUACHUCA
CORONADO NAT'L. MEM
BISBEE (OPEN PIT MINE)
CHIRICAHUA NAT'L. MON
AND POINTS EAST

KEY

- ① ARIZONA-SONORA DESERT MUSEUM
- ② "OLD TUCSON" MOVIE SET
- ③ SAN XAVIER MISSION
- ④ MUNICIPAL AIRPORT
- ⑤ UNIVERSITY OF ARIZONA
  ARIZONA STATE MUSEUM
  ARIZONA PIONEERS' HIST. SOC.
- ⑥ RANDOLPH PARK
- ⑦ SABINO CANYON
- ⑧ SAGUARO NAT'L. MONUMENT
- ⑨ COLOSSAL CAVE

DIRECTIONS
(By George!)

NEV.
UTAH
COLO.
CAL.
ARIZONA
N. MEX.
TUCSON
U.S.A.
MEX.
BAJA CAL.
SONORA
CHIH.

(ADAPTED BY
DAVID F. CARSWELL
FROM A MAP BY
THE CITY - COUNTY
PLANNING DEPT.)

DC. USA.

chance to stake out our claims on Rapa.

(I keep finding odd monocot pollen grains and must get more comparative material as soon as possible. I need Zingiberaceae(one may be a Curcuma), Taccaceae (I have two, but need more) , Commelinaceae and Musaceae.....Marie Neal isn't too good at sending samples at present, but Eddie Bryan would be help, he says. He might peak out a few scarps and send them along with you. All he has sent so far has been most useful. Annetta Carter(Berkeley) has also sent pollen of 13 spp. Unfortunately most of her Rapa material--which seems to be extensive-- has no pollen.

Can you get any samples of flowers of Balanophora ? This may be important. Any Balanophoras--the more the better.. I have B. fungosa, but must check that as I believe Croizat lists a different species for Rapa.

The Rubiaceae may be important: I think that family should be treated

Jan 75. DC. USA.

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TO PHOENIX & WEST COAST
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7 SABINO CANYON
8 SAGUARO NAT'L. MONUMENT
9 COLOSSAL CAVE
DIRECTIO
(BY GEORG

Mrs. WATSON SMITH
5045 EAST GRANT ROAD
TUCSON, ARIZONA

I have a sketch of N.Z. and Hawaiian bog formers (Oreobolus and Donatia) if you wished to use it... It was prepared for Verdoorn when he planned to bring out a book on Peat Deposits of the World. It has never been printed. L.

Sunday

Dear Ray:

Al Mead rang a short time ago to say that you would cor at Easter time. He wasn't too sure whether you would afrive on A He said he would write you and arrange to meet you at the airpor.. I have told him to bring you here. You can have the guest-room, if you don't mind one in a Museum. It has all be cleaned up for friends due today, and others due from Malaya at the end of April. I cannot offer much except talk, but I think that is what you have come for. We can see that you get in to see Al or Paul Martin and so make good use of your time.

You have not heard from me because I have been sick and am in the frustrated frame of mind that makes me wish to underline everything. I am wholly better this week, but have had recurrent influenza all of Jan. and Feb. Never had anything like it: next Feb. I think we'll go away to a more equable climate and dodge this odd spring climate here. We had snow on the mts. today, after 84° temperatures two days ago: that is typical. I think I got run down before Xmas, and tried to do too much with the microscope at night.

I got a friend to make prints of the Hawaiian negatives, but they are only so-so. I enclose some. I could still send you the negatives, of course. Unfortunately my helper lost my treasured negative of Selling stick in a mucky path on Kauai: that has been bad luck.

Congress: I sent in the proposed annangement, changing the title to:--
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Mrs. WATSON SMITH
5045 EAST GRANT ROAD
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It will thus be a sort of progress report on pollen work in the Pacific.

To my chagrin Dr. Smith wrote last week to say that he thought I wanted a four hour session. I have been told, I understood, to arrange one of 2 hours with 3-4 speakers. He left the matter open, so I wrote back at once accepting the longer time and explaining that it would help greatly in developing the arguments. Chaney will now have more time to introducem to lead comments after papers or at the end , and I have suggested that he give his introductory comments a title* something like a"Macropalaeontologist looks at Fossil Pollen" . He can be as critical or as appreciate as he likes and thus inform the audience about what is going on in general in palaeontonology.He has been most co-operative so far,and all will be well, if he turns up. I have heard that he can change plans without much warning.

He wants to add in a Dr. Tokunaga from Japan. He has offered to read his paper--on Eocene pollen from Japan, so I have now accepted. He says neither Tokunaga nor Ueno(the other man, whom he recommended first and whom,unfortunately, we invited) should try to deliver papers in English).

Thus there is some chance to compare the northern and southern deposits and microfossils over a considerable period....The mangroves will be of general interest as a lot of attention is now being paid to them in Europe, in this country,and by Croizat. The southern hemisphere is a little short just now, and I am worried as Balme has not written since term began at the beginning of March. He had had no word then about getting any financial aid. Without aid from the N.S.F. he is in a bad position in seeking aid from his University or his Govt...He went to India two years ago and is afraid the Univ. won't help now,as they are so short of funds. He suggests very aimably that I could read his paper if he failed to turn up, but it is rather beyond me. He is a to-notcher, and most highly spoken of by Dr. Edna Plumstead, who is just about to come out with a strking contribution on the older fossil deposits from which the Fuchs-Hillary Exped. collected....You should watch for her papers on Glossopteris too: they are used by Melville in his theories about the devt. of the angiosperm flower(Nature, Oct.1, 1961: long article).(Or was it Feb.1: I cannot remember). She agrees with me about Antarctica but has far more evidence than I have had for somewhat revolutionary views.I have offered her some of my new evidence, and have told her I intend to send a note in to Nature about it as soon as possible.

With two hours extra in hand,me may be in difficulties, if Balme does not come, so I have reinvited Dr.Isabel Cookson by cable,and have also asked Vishn-Mittre(Birbal Sahni Institute) by cable.I am waiting for their replies now. Cookson might come, as she indicated too late that she would have accepted my first invitation if there had been any suggestion that help would be available. Vishnu-Mittre might be able to come, as he has been asking questions about it for some time.Florin backs him very strongly, so I have asked him to do a short paper on trisaccate grains: this brings in the Pacific area, Antarctica,and Kerguelen; and then the Gondwana areas/ He has plenty to say as he has been telling me his views in recent letters/

If neither can come I am afraid I could not have more papers read,as that would throw too much on Chaney, Jane Gray and myself.

This is a suggestion--not just an alternative: Would you be willing to collaborate with Stella Leopold and myself in giving a piece on Rapa? I did not invite Stella originally as I did not know of her work on the western borings, nor that she had that Rapa sample. I think I shall telephone her and get an opinion from her. I'd then ask her to deliver the paper, if she could come to the Congress.She may, of course, be going to the INQUA one in Poland......If she cannot do it, perhaps you and I could do it, and you could deliver it. The pollen side would be slight, comparatively,and you could handle it if I got slides ready. By then you will have the note in Nature to refer to. (I am sure they will accept it,as they like controversial things). PLEASE SEND ME A CABLE OR AIRMAIL LETTER AS SOON AS POSSIBLE, AS SMITH GIVES ME ONLY UNTIL MARCH ~~1ST~~ 31st. to inform him about full list of speakers , titles, times, summaries, etc. I think this would be a chance to stake out our claims on Rapa.

(I keep finding odd monocot pollen grains and must get more comparative material as soon as possible. I need Zingiberaceae(one may be a Curcuma), Taccaceae (I have two, but need more) , Commelinaceae and Musaceae.....Marie Neal isn't too good at sending samples at present, but Eddie Bryan would~~he~~ help, he says. He might peak out a few scarps and send them along with you. All he has sent so far has been most useful. Annetta Carter(Berkeley) has also sent pollen of 13 spp. Unfortunately most of her Rapa material--which seems to be extensive-- has no pollen.

Can you get any samples of flowers of Balanophora ? This may be important. Any Balanophora--the more the better.. I have B. fungosa, but must check that as I believe Croizat lists a different species for Rapa.

The Rubiaceae may be important: I think that family should be treated monographically(for pollen types)...

The total of species for Rapa is still not high, so don't let me raise your hopes too much. This is odd, somehow, as some delicate grains are marvellously well-preserved. Bailey did not agree that my tracheids were from an Araucarian: I have lost faith in identifiying this family from wood elements, anyway: most of the literature is conflicting....

The conifer pollen remains, but its now more difficult to handle. You will see what I have done about it in the Nature article: I did not attempt to hang the whole story on it, as I had hoped to do . The title now is(if approved by Nature):- "RAPA NEGLECTA: A Thimbleful of Continentality". The previous one was " A Rapa Conifer: Contaminant, endemic, or Gift of the West Wind Drift?" We may still use that title/Tell me at once if you prefer the second title.

My guests are overdue, so this letter has grown longer.

Best wishes,

Lucy

P.S. If you send a cable you can use our Tucson Tel. number: East 6.9607.That helps get it to use quickly. Address it to me as MRS. WATSON SMITH.

Les

monographically(for pollen types)...

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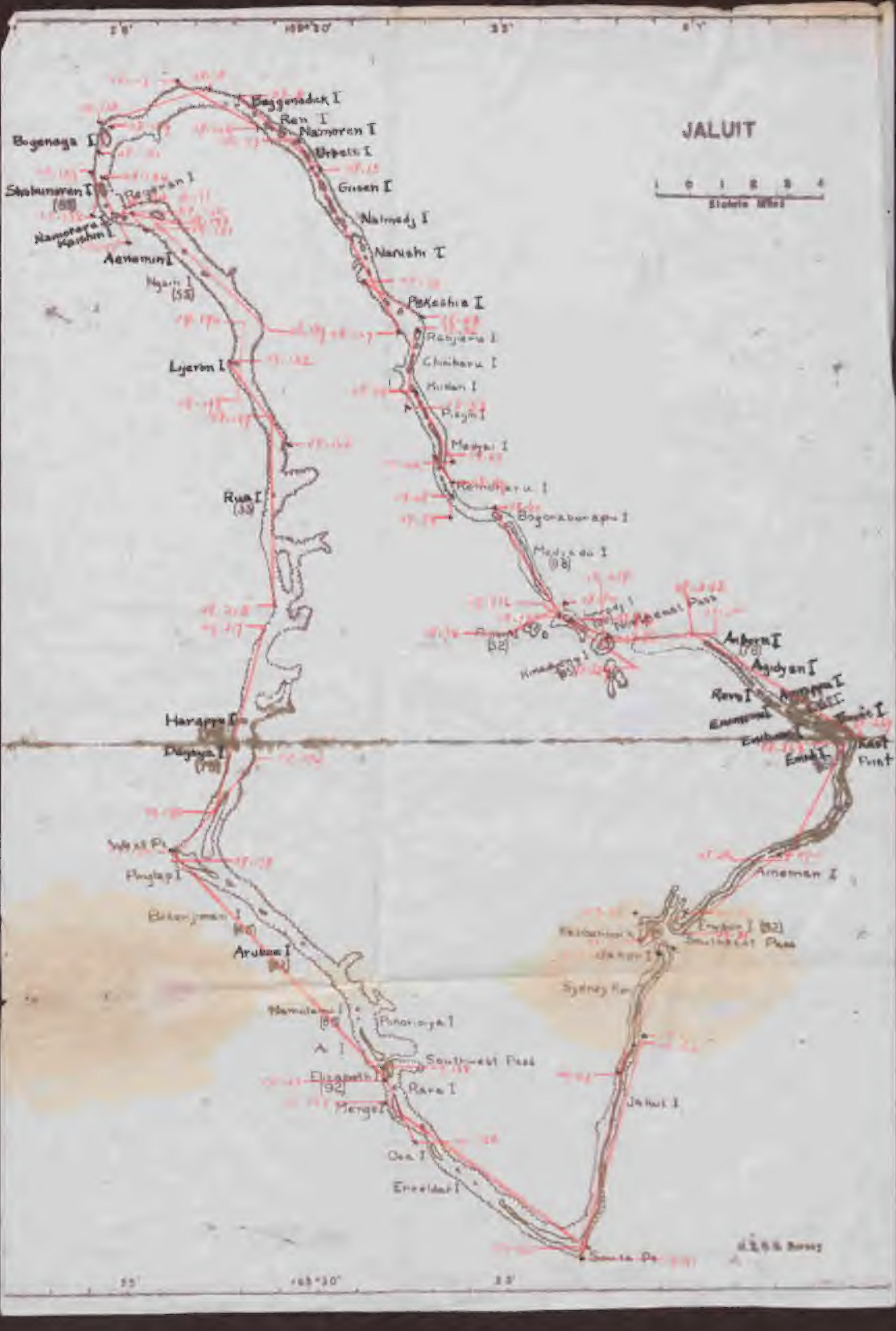
L.C.S.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Kaishin I
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Chniharu I
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Piegm I
Medjai I
Lijeron I
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Aiberu I
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Agidyen I
Reve I
Emmemai I
Emibukoel I
Emidj I
East Point
Harappa I
Digaya I
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West Pt.
Pinglap I
Bikerijmen I
(88)
Arubae I
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Ainemen I
Enybor I (82)
Kabbenbock I
Southeast Pass
Jabor I
Sydney Pier
Namolamu I
(86)
Pokoraiya I
A. I
Southwest Pass
Elizabeth I
(92)
Rare I
Merge I
Jaluit I
Oea I
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FRANK ABNER HECHT
3263 DIAMOND HEAD ROAD
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DC USA.

monographically (for pollen types)...

The total of species for Rapa is still not high, so don't let me raise your hopes too much. This is

8th NATIONAL
WATERSHED CONGRESS

PRO

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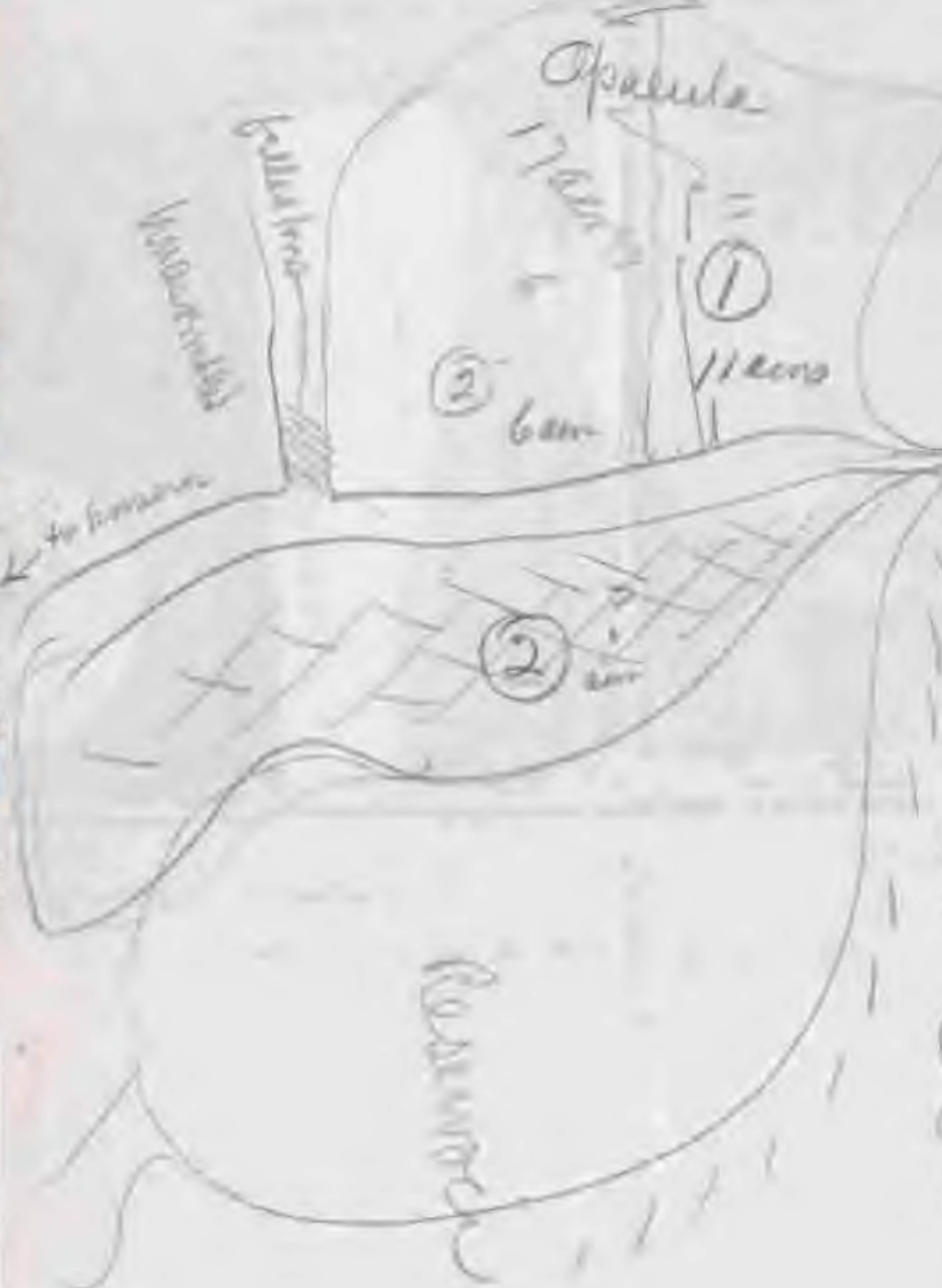
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① For Bird
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Arboretum
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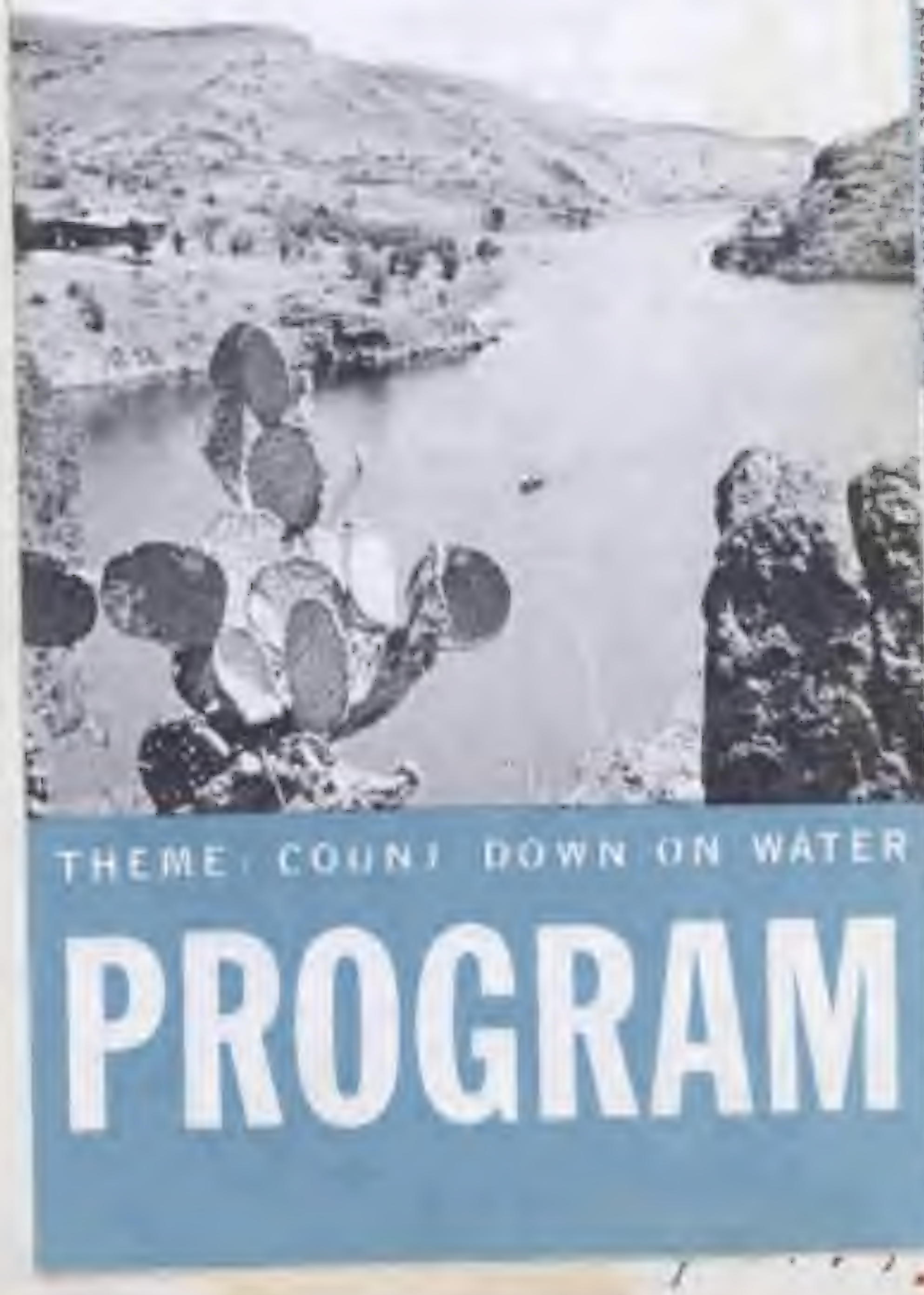
8th NATIONAL WATERSHED CONGRESS

RAMADA INN

TUCSON, ARIZONA

APRIL 17, 18, AND 19, 1961



THEME: COUNT DOWN ON WATER

PROGRAM

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CONDITIONS UPON WHICH THIS COLLECTING PERMIT IS ISSUED

It is the intention of the National Park Service to further scientific research within the areas administered by it, and to cooperate with technical workers to the fullest extent compatible with its charge to preserve all species of flora and fauna and all geologic material in a natural state, insofar as is possible.

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USA.

THEME: COUNT-DOWN ON WATER

PROGRAM

SUNDAY, APRIL 16

3:00 p.m.	Registration ***Lobby, Ramada Inn***
8:00 p.m.	Special Motion Picture Program ***Ramada Room***

MONDAY, APRIL 17

8:00 a.m.	Registration ***Lobby, Ramada Inn***

SESSION 1

Ramada Room

Theme: "Planning for Water Use"

9:50 a.m.	Formal Opening C. R. Gutermuth, Chairman, Steering Committee, National Watershed Congress
10:00 a.m.	Water Needs of the Nation 1980-2000 Hon. Robert S. Kerr United States Senator from Oklahoma
10:30 a.m.	Discussion
10:40 a.m.	Soil and Water Conservation Needs Inventory Donald A. Williams, Administrator, U. S. Soil Conservation Service, Washington, D.C.
11:10 a.m.	Discussion
11:20 a.m.	Legal Barriers in Water Use Planning Frank J. Trelease, Dean, College of Law, University of Wyoming, Laramie
11:50 a.m.	Discussion
12:00 noon	Recess
12:15 p.m.	Luncheon, ***Plantation Room*** James B. Craig, Presiding Address of Welcome Arthur N. Pack, President, Charles Lathrop Pack, Forestry Foundation, Tucson Development of "Water Street U.S.A." William H. Carr, Founder and Director Emeritus, Arizona-Sonora Desert Museum, Tucson

SESSION 2

2:00 p.m.	Buses leave Ramada Inn for meeting on "Water Street U.S.A."
5:30 p.m.	Buses leave for "Old Tucson"
6:00 p.m.	Reception, chuck wagon dinner, and entertainment at "Old Tucson"

TUESDAY, APRIL 18

8:00 a.m.	Registration ***Lobby, Ramada Inn***

SESSION 3

Ramada Room

Theme: "Multiple Use of Watersheds"

	William E. Richards, Presiding
9:00 a.m.	Opportunities in Multiple Use of Watersheds Harold G. Wilm, Commissioner, New York State Conservation Department, Albany
9:30 a.m.	Discussion
9:50 a.m.	Water for Agriculture, Industry and Recreation Hon. Frank J. Welch, Assistant Secretary of Agriculture, Washington, D. C.
10:20 a.m.	Discussion
10:40 a.m.	Motivating Multiple Use of Watersheds Marvin Melton, President, Arkansas State Chamber of Commerce, Little Rock
11:10 a.m.	Discussion
11:30 a.m.	Recess
11:45 a.m.	Luncheon, ***Plantation Room*** John H. Jones, Presiding Life Zones in Evidence on Spectacular Mt. Lemmon Norman P. Weeden, Supervisor, Coronado National Forest, Tucson
1:30 p.m.	Buses leave Ramada Inn for Mt. Lemmon tour
5:00 p.m.	Buses return to Ramada Inn
7:00 p.m.	Reception, ***Plantation Room***
7:30 p.m.	Annual Dinner, ***Ramada Room*** *Toastmaster:* C. R. Gutermuth, Chairman, Steering Committee, and Vice-President, Wildlife Management Institute, Washington, D. C. *Presentation of Awards:* Watershed of the Year Watershed Man of the Year *Principal Speaker:* "How Small Watershed Programs Help Communities Grow" L. L. Males, President, Security State Bank, Cheyenne, Oklahoma "Desert Ark" live animal demonstration by Hal Gras, Tucson. Music will conclude the program

WEDNESDAY, APRIL 19

SESSION 4

Ramada Room

Theme: "Water for a Thirsty Land"

	John I. Taylor, Presiding
9:00 a.m.	Arizona Water Management Programs Andrew L. McComb, Head, Department of Watershed Management, University of Arizona, Tucson
9:30 a.m.	Discussion
9:45 a.m.	Water Yields from National Forests Richard E. McArdle, Chief, U. S. Forest Service, Washington, D. C.
10:15 a.m.	Discussion
10:30 a.m.	Watershed Management on Public Lands Karl S. Landstrom, Director, Bureau of Land Management, Washington, D. C.
11:00 a.m.	Discussion
11:15 a.m.	Watershed Management to Serve Reclamation Needs LaSelle E. Coles, President, National Reclamation Association, Prineville, Oregon
11:45 a.m.	Discussion
12:00 noon	Recess
12:30 p.m.	Luncheon, ***Planation Room*** William E. Richards, Presiding Future Water Needs for Recreation Francis W. Sargent, Executive Director, Outdoor Recreation Resources Review Commission, Washington, D. C.
3:30 p.m.	Special meeting for representatives of participating organizations. ***Ramada Room***

THURSDAY, APRIL 20

	Post-Congress tour of the Agricultural Research Service's Walnut Gulch Watershed. The 65-square-mile experimental project is located near Tombstone. This guided tour will take the greater part of the day. A luncheon stop will be made in Tombstone.
8:00 a.m.	Buses leave Ramada Inn

HOTELS & RATES

RAMADA INN
Single: $8.00-10.00
Double: $9.00-12.00
Twin Beds: $9.00-12.00

TUCSON DESERT INN
Single: $8.00-10.00
Double: $8.00-12.00
Twin Beds: $9.00-12.00

SANDS MOTOR HOTEL
Single: $8.00-10.00
Double: $8.00-12.00
Twin Beds: $9.00-12.00

HOLIDAY INN
Single: $8.00
Double: $9.00
Twin Beds: $11.00

TO: WATERSHED CONGRESS HOUSING BUREAU
c/o Tucson Convention Bureau
P. O. Box 991
Tucson, Arizona

1st Choice Hotel ....
2nd Choice Hotel ....

I plan to attend the Eighth National Watershed Congress on April 17-19, 1961.

Name .... Title ....

Organization .... Address ....

Please reserve me a single room ☐, Double ☐, Twin beds ☐ for arrival on ....

and departure on .... (Reservations will not be held after 6:00 p.m.)

Send confirmation to ....

Enclosed is $.............. for **ADVANCE REGISTRATION** for ....persons (at $5 each) named below:

....

....

(Make checks payable to the Eighth National Watershed Congress)

CONGRESS STEERING COMMITTEE

C. R. Gutermuth
Chairman
Vice-President, Wildlife Management Institute
Washington, D. C.

James B. Craig
Editor
American Forests
The American Forestry Association
Washington, D. C.

John H. Jones
Secretary-Treasurer
American Watershed Council
Fairmont, West Virginia

William E. Richards
President
National Association of Soil Conservation Districts
Holdrege, Nebraska

John I. Taylor
Assistant Legislative Director
American Farm Bureau Federation
Washington, D. C.

PARTICIPATING ORGANIZATIONS

American Farm Bureau Federation
American Fisheries Society
American Forestry Association
American Nature Association
American Planning and Civic Association
American Pulpwood Association
American Watershed Council
Chamber of Commerce of the United States
Intern'l Ass'n of Game, Fish and Conservation Comm'rs
Izaak Walton League of America
National Association of County Officials
National Association of Manufacturers
National Ass'n of Soil Conservation Districts
National Audubon Society
National Farmers Union
National Grange
National Parks Association
National Reclamation Association
National Wildlife Federation
Nature Conservancy
Outdoor Writers Association of America
Society of American Foresters
Soil Conservation Society of America
Sport Fishing Institute
Wilderness Society
Wildlife Management Institute
Wildlife Society

ARIZONA LOCAL COMMITTEE

Dr. Andrew L. McComb, Chairman, University of Arizona
Joseph Arnold, Arizona State Land Office
Robert V. Boyle, U. S. Soil Conservation Service
William Carr, Pack Forestry Foundation
Mrs. Hoyd Deckard, Arizona Federation of Women's Clubs
Hon. Lewis H. Douglas, Valley National Bank, Tucson
Mrs. H. Earle, Arizona Federation of Garden Clubs
C. Edgar Goyette, Pioneer Hotel, Tucson
Hal Gras, Arizona-Sonora Desert Museum
Dr. Reuben G. Gustavson, University of Arizona
Mrs. C. R. Hensing, Arizona Federation of Women's Clubs
Joseph Wood Krutch, Tucson
Marvin Morrison, Arizona Farm Bureau Federation
Dr. W. G. McGinnies, University of Arizona
C. M. Palmer, Jr., Tombstone
E. I. Rowland, Bureau of Land Management
Robert J. Smith, Arizona Game and Fish Commission
Dr. Lyle K. Sowls, University of Arizona
Jack Weadock, Arizona Daily Star, Tucson
Mrs. Mabel Weadock, Tucson
Norman Weeden, U. S. Forest Service
William H. Woodin, III, Arizona-Sonora Desert Museum

PRESS ROOM

Rodeo Room on Mezzanine Floor
Daniel A. Poole, in charge

TICKET INFORMATION

Registration	$ 5.00
Luncheon, Monday, April 17	2.50
Session II, Monday, April 17 Includes all transportation and visit to "Water Street U.S.A." at the Arizona-Sonora Desert Museum; Reception, Chuck Wagon Dinner, Admission, and Entertainment at "Old Tucson"	7.00
Luncheon, Tuesday, April 18	2.50
Mt. Lemmon Bus Tour	2.00
Reception and Annual Dinner	6.00
Luncheon, Wednesday, April 19	2.50
Total when purchased individually	$27.50
Special combined price for all tickets	$25.00
Post-Congress Tour of Walnut Gulch Watershed, Thursday, April 20	$ 3.00

Eighth National Watershed Congress
709 Wire Building • Washington 5, D. C.

8th NATIONAL WATERSHED CONGRESS

RAMADA INN
TUCSON, ARIZONA
APRIL 17, 18, AND 19, 1961

THEME: COUNT DOWN ON WATER

PROGRAM

374

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CONDITIONS UPON WHICH THIS COLLECTING PERMIT IS ISSUED

It is the intention of the National Park Service to further scientific research within the areas administered by it, and to cooperate with technical workers to the fullest extent compatible with its charge to preserve all species of flora and fauna and all geologic material in a natural state, insofar as is possible.

1. This permit applies only to animal life, plants, rocks and minerals. Archeological and paleontological materials may not be collected under this permit.

2. The collections shall be used for scientific or educational purposes only, shall be dedicated to public benefit, and shall not be used for commercial profit.

3. All collecting must be done away from roads, trails, and developed areas, unless such localities are specified in the permit. The collecting shall be conducted in such a manner as not to attract attention or to cause damage to the environment. Because of the scarcity or importance of some specimens, Service officials may designate the kind, number and sizes of specimens which may be collected, and any other restrictions necessary to the preservation of the area.

4. The National Park Service reserves the right, in the interest of science, to designate the depository of all specimens removed from a national park or monument and to approve or restrict transfers of specimens between depositories. The National Park Service also reserves the right to designate the U. S. National Museum as the depository of any type specimen removed from a national park or monument, after the collector has made necessary studies and published the results of his research thereon.

5. The Superintendent may require the permittee to furnish an inventory and locality description of any or all specimens proposed to be collected before they are removed and, after the collection is assembled, to submit it for examination.

6. Use or Disposition of Preserved Specimens: The collected specimens shall be deposited in a permanent public museum or in the exhibit, study or type collections of scientific or educational institutions. They must be suitably recorded in a permanent file and must be available to the public.

15548

ogeration Project
/o National Research Council
Washington 25, DC. U.S.A.

Eighth National Watershed Congress
709 Wire Building • Washington 5, D. C.

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LCS

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dc8

United States Department of the Interior
National Park Service

COLLECTING PERMIT

CLASS B

In Accordance with the Conditions and Restrictions Appearing on the Back Permission is Granted

Name of Collector F. Raymond Fosbert	Area Hawaii National Park	Date Issued March 27, 1961
To Collect the Following Specimens Plants, including one flower only from Hibiscalphus		Expiration Date April 10, 1961
Locality of Collecting Limited to Hawaii National Park		
Special Conditions or Restrictions Do not collect along trailside or roadside		
Approved (Signature) Fred T. Johnston	Title Superintendent	

** Two classes of collecting may be conducted under this permit:*

Class A - That required for public exhibits and for research undertaken by persons who can establish their connection with public museums or other scientific or educational institutions. Specimens collected may be insects (Hexapoda), spiders (Araneida), plants, rocks, or minerals, as designated in the permit.

Class B - That undertaken by Federal employees only for scientific or educational purposes. Specimens collected may be plants, rocks, minerals or animal life as designated in the permit.

The collecting of endangered or vanishing species of animals, if permitted at all, will be allowed only where the required approval has been obtained from the Director of the National Park Service

THIS PERMIT MUST BE CARRIED AT ALL TIMES WHILE COLLECTING. SEE REVERSE FOR CONDITIONS AND RESTRICTIONS.

F. R. Fosberg
Book # 59
begins with 41374
(Nos. 41500-599 are in book 58 starting p. 52)

Standard
Miniature Blank
Book

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c/o National Research Council
Washington 25, D.C. U.S.A.

P.S. If you send a cable you can use our Tucson Tel. number: East 6.9607. That helps get it to use quickly. Address it to me as MRS. WATSON SMITH.

United States Department of the Interior
National Park Service

COLLECTING PERMIT

CLASS R

In Accordance with the Conditions and Restrictions Appearing on the Back Permission is Granted

Name of Collector
Area Hawaii National Park
Date Issued March 27, 1961
To C
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Expiration Date April 10, 1961
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undertaken by persons who can establish their r educational institutions. Specimens collected nts, rocks, or minerals, as designated in the

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if permitted at all, will be allowed only where he National Park Service

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EE REVERSE FOR CONDITIONS AND RESTRICTIONS.

F. R. Fosberg
Book # 59
begins with 41374
(Nos. 41500-599 are
~~in book~~ 58 starting
~~p. 52~~)

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A BOORUM & PEASE PRODUCT

Pacific Vegetation Project
c/o National Research Council
Washington 25, DC. USA.

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Book # 59
begins with 41374
(Nos. 41500-599 are
in book 58 starting
p. 52)

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Made in U. S. A.

A BOORUM & PEASE PRODUCT

Pacific Vegetation Project
c/o National Research Council
Washington 25, D.C. U.S.A.

2 spp. subterranean termites
1 dry wood termite

scale Icerya purchasi Mask.

fly Chrysomya megacephala

termite (Blatella germanica (L.)
Periplaneta americana (L.)

beetle, to control scale Rhodolia cardinalis

rats
mice

1960 Johnston Island

Oct 17 Visited at night – Terminal.
Thespesia populnea – planted in front of Terminal, to 3 m. tall.
Terminalia catappa – 1 planted in Terminal area, 7 m.
Cocos nucifera – planted; trunks less than 1 m.
Chloris inflata – abundant
Conyza bonariensis – abundant
Pluchea indica – no seen.
Pluchea odorata – " "
Cenchrus echinatus – common
Eleusine indica – occasional
Cyperus rotundus

Kwajalein
ask for copies of his [illegible]

Mr. Clegg – Preventive Medicine Unit 6, Pearl Harbor.
Behind Dental Dispensary in P.X.
turn left, second turn to rt after entering

Mr. Newsom, hospital Administrator says there are very few black widow spiders here now.

{ District Public Works Office
Fourteenth Naval District
memo to Commanding Officer
Pacific Missile Range Facility, Kwajalein
no. 3355 dated 20 May 1960
signed N. M. Martinson

1960 Johnston I. — Kwajalein Atoll

Oct. 17 – Johnston Island

1 41,374 Cyperus rotundus L.
locally forming patches around Terminal area.

Kwajalein Atoll

Oct. 19 – Kwajalein Islet
on ~~[illegible]~~ filled coral soil

1 75 Psilotum nudum (L.)
occasional between cobbles bordering walks around chapel.

5 76 Hedyotis corymbosus (L.) Lam.
abundant, forming lawn in places near Terminal

2 77 Eleocharis geniculata R. & S.
abundant very locally in marshy ~~[illegible]~~ spots

4 78 Pluchea indica × odorata
very common locally with both parents in open flats and roadsides.

Oct. 21 – Kabbenbock Islet, Jaluit Atoll

3 79 Hibiscus tiliaceus L.
very local, probably planted on coral sand and small gravel

1 {80 fungus
{81 fungus
on dead coconut log

1 82 ~~alga.~~
abundant on shores of strongly brackish pond

41378a Cynodon dactylon ✓
in meadow; creeping; scabrous ext.

prostrate. flowers very pale pink.

rather low, compared with both parents, stems tending to branch corymbosely; flowers mauve.

small twisted tree, 5 m. tall; leaves rather chlorotic; flowers bright yellow with maroon center

1960 Kwajalein - Marshall Is.

Oct. 19 - Kwajalein Islet
General appearance more luxuriant than I have seen it previously. Coconut trees bearing, around old admin Bldg. site.

planted or Cult. plants (a.w. = also seen wild)
Hymenocallis littoralis
Thespesia populnea
Pseuderanthemum carruthersii
var. atropurpureum
Coccoloba uvifera
Hibiscus rosa-sinensis (or hybrid)
Nerium sp.
Pandanus tectorius
Cocos nucifera
Casuarina equisetifolia
Crinum asiaticum
Catharanthus roseus
(a.w.) Ipomoea pes-caprae var. brasiliensis
(a.w.) Tournefortia argentea
Terminalia catappa
Ochrosia oppositifolia
Pedilanthus tithymaloides
Vitex trifolia
Codiaeum variegatum
Clerodendrum inerme

Native plants not planted:
Vigna marina
Scaevola sericea
Fimbristylis cymosa
Triumfetta procumbens
Wedelia biflora
Cassytha filiformis
Lepturus repens

Weeds (* common at least locally)

* Desmodium canum
* Synedrella nodiflora
* Phyllanthus amarus
* Euphorbia prostrata
* Euphorbia thymifolia
* Eleusine indica
* Euphorbia hirta
* Emilia javanica
Cyperus rotundus
Paspalum distichum
* Paspalum longipilum
* Cyperus compressus
* Tridax procumbens
Cenchrus echinatus
* Eclipta alba
* Stachytarpheta jamaicensis
* Hedyotis corymbosa
* Vernonia cinerea
Dactyloctenium aegyptium
* l Chrysopogon aciculatus
* Heliotropium ovalifolium
var. depressum
Portulaca oleracea
Cynodon dactylon
* ~~Cyperus sp.~~ Pluchea indica
* l Physalis angulata
Conyza canadensis
* Bidens radiata
* l Pluchea odorata
* Centella asiatica
Euphorbia cyathophora

1960 Marshall Is.

On airstrip in sun in afternoon (>80 per.) 7 curlews (probably whimbrels, from their note), a number of golden plovers, and a considerable flock of turnstones. Golden plovers common generally.

Old nursery in former terminal – now being used otherwise. Only a Euphorbia pulcherrima bush, a clump of tiny Alocasia, and a vine of Epipremnum pinnata (?) climbing on a coconut tree left of nursery stock.

ALOCASIA

EPIPREMNUM

Physalis

Physalis angulata abundant.

IPOMOEA

A patch of Ipomoea batatas cultivated in old patio area.

pato

(batatas)

Generally, the weeds that were previously ~~are~~ found only in the old terminal area have spread throughout the island e.g. Bidens radiata, Cyperus compressus, Paspalum longipes, Heliotropium ovalifolium, etc. Some, such as Conyza canadensis, Pluchea indica, P. odorata, Hedyotis corymbosa, + Chrysopogon aciculatus have remained localized, though ~~[illegible]~~ most of these are very abundant locally. The hybrid between Pluchea indica and P. odorata has

Kwajalein

become very common between the old and new terminals. Some variation evident, but not much.

Few of the ornamentals from the old nursery seem to have persisted in the planting around the island. Hymenocallis is abundant. Vitex and Pedilanthus somewhat so.

Oct. 20 – flight Kwajalein – Majuro.

Passed Namu on right. Most islets are on the east side.

Passed Jabwot – a very tiny pancake, too far away to see clearly. Ailinglaplap also.

Reef north from Majuro I. has a ridge exposed at low tide about 1/4 back from seaward side. Small coral patches well scattered eastward in lagoon. ~~At least on south side~~ more numerous eastward, esp. on north side. Large patch with sand bars bare at low tide, about 3/4 way east on north side where north reef breaks in. North reef with many islets and cross patches of exposed rock at low tide. Island on south side almost continuous.

Majuro – Jaluit flight.
Reef flat ~~very~~ narrow along southeast coast of Majuro. No very appreciable algal ridge. Along south coast the reef flat is rather narrow. There seems to be an elongate pond occupying the place of the islets in the intervals between islets on the south reef.

Circled Jaluit clockwise from n. of Mejatto ~~from so. pass~~ inside.
Bars along lagoon reef flat

close to lagoon very common. Scattered rubble but no bars on outer reef flats. Surge channels all around, but very little development of algal ridge.
Very striking bifurcating channels inside both passes.
(photos beginning slightly after we first crossed reef mostly along east side from Mejatto to South Point, a few on south side, Kuah and Lijeron Islets, some of submerged coconut trunks on east side at north and near Mejatto.

Marshall Is.

Oct. 20 - Jabwor, south of old radio station.

Almost entire denuded area has become covered by a mat of Wedelia, Vigna, and Ipomoea, extending almost to the low cobble ridge which is the ridge that was on the reef flat. The Ipomoea has sent a thin network of strands many meters long out towards the ~~to~~ cobble ridge. The denuded flat just back of the ridge, is only very thinly covered, in places still bare.

Few scattered Tournefortia and Scaevola locally on this area. This mat extends to perhaps 200 m. beyond the old Weather tower. Beyond this there is little herbaceous growth, except a few small patches of Triumfetta and Canavalia. There are scattered small Tournefortia and Scaevola, and abundant clumps of sprouts from the old Pemphis stumps, there and a few small Lepturus patches [illegible] roots covered by sea water at high tide. Many Pandanus seedlings.

address it to me as MRS. WATSON SMITH.

Jaluit Atoll

Between the Japanese Weather Tower and Sydneytown there is not a single standing coconut tree or stump, dead or alive, and only two or three dead Pandanus snags, no living ones.

Rough platform remnants about midway between Jabwor and Sydneytown are not very much indurated. ~~S~~ Sample 11 from about 1 m. above high, high tide level. This layer is being undercut in various places, especially on lagoon side, where looser layer ~~th~~ between two indurated ones is exposed.

Very little loose material on this part of land strip. Here, for some hundreds of yards, the ~~reef~~ ridge that was on the reef has vanished, at least from sight at ~~to~~ high tide, and it is not obvious where the material has gone. The vegetation is of sparsely and irregularly distributed Tournefortia bushes to m. tall, a few small Scaevola, and a

1940 Marshall Is.

few dense clumps of Pemphis sprouts along lagoon edge. A few seedlings —
Scaevola, Tournefortia, Ipomoea pes-caprae (?).
Two wandering tattlers on lagoon reef.

Oct. 21, Jabwor —
Three ruddy turnstones on lagoon beach.
Polypodium scolopendria, Euphorbia hirta common in Wedelia mat on loose boulder deposit along lagoon near old radio station.
Terminalia catappa trees here are growing vigorously, other than a sort of beaten appearance, with some dead branches, not showing any effects of typhoon.
A few Pandanus trees alive and normal, a few rather broken but still alive. Some old snags. Clump of Casuarina seem in very good shape.
Coconuts planted generally in pits. Mostly very healthy, some are yellowish.

it to use quickly. Address it to me as MRS. WATSON SMITH.

lib

Jaluit

Kabbenbock
Oct. 21 — ~~[illegible]~~ I.
south part of I reef is of very coarse broken coral, with locally some bars of finer gravelly but sharp light colored material piled on top.
Islet said to have been two islets, joined by an early typhoon.
Inner end of islet surrounded by coarse beachrock, some finer. Small beach ridge of coral gravel.

Trees seen:

Tournefortia	Pemphis Pemphe
Pandanus	Calophyllum
Scaevola	
Cordia	
Barringtonia asiatica (seedling)	
Morinda citrifolia	
Guettarda	
Hernandia	
Terminalia	
Hibiscus tiliaceus	

Herbs Crinum

Wedelia	Fimbristylis
Ipomoea tuba	Hedyotis biflora
Polypodium scolopendria	
Asplenium nidus	
Canavalia microcarpa	
Vigna Vigna marina	
Lepturus	
Tacca	Euphorbia hirta

1960 Marshall Is.

1 bristle-thighed curlew
2 fairy terns
3 common noddies
2 tattlers
2 reef herons, one speckled, one white with small peachy shoulder patches.

On seaward side is a small embayment that has been dammed off probably by the typhoon, by a ridge of gravel, enclosing a pond. water not quite salty as sea water, abundant green algae, some blue green.

Cordia Tipped over Hernandia and Terminalia trees growing vigorously Healthy upright sapling of Terminalia.

Front reef facing passage has a broad relatively smooth fine grained planation surface, perhaps 100 m. wide, sloping off rapidly, seaward, with active coral growth for 5-6 m. down. Then debris to flat sandy (?) bottom of pass (see Knudson). Landward a very flat erosion ramp up to 100 m. wide (in embayment) much narrower elsewhere. fairly rough, peeling off at edges (kod. photos). a few and in layers.

get it to use quickly. Address it to me as MRS. WATSON SMITH.

remnants of beach-rock to south.

Platform here at about high tide level

Scattered medium size boulders on reef flat and ramp. up to 0.5 m. diam., irregular.

Some fair sized areas of old surface that seems to be an old growth surface of ~~ola~~ Acropora.

Scattered boulders of vesicular lava from ballast of wrecked ship

On inner shore there are extensive low-tide level flats with a rather narrow platform perhaps 8-10 m. wide protruding from ~~reef~~ islet, with narrow erosion ramp, peeling off in 2 layers. Undercutting + collapse. (kod.) (kod. of platform).

Pieces of a [illegible] somewhat vesicular black volcanic rock up to 20-25 cm. long scattered on boulder beach on inner side, apparently carried around from the wreck on the outer ~~bea~~ reef. abundant on outer beach.

Very few coconut trees left on this islet, a few of those lying down have turned up at tips

1960 Marshall Is.

From lagoon about 8 standing coconut trees visible in vicinity of Sydneytown, mostly around tanks.

Jabwor –
1 whimbrel on seaward side.

Hemigraphis reptans around old masonry foundation, barely holding on.
Hymenocallis littoralis very common very luxuriant, covered by sea water at high tide

Bananas planted abundantly and growing luxuriantly around old ruins.
Breadfruit – vigorous sprouts from old uprooted tree, small upright tree in very good shape.
Cyperus kyllingia locally abundant but dwarfed!
Ocimum sanctum, Catharanthus roseus, Mirabilis and yellow hybrid Cannas planted in front of houses doing well.
A few patches of sweet potatoes in sheltered spots doing very well.

get it to use quickly. Address it to me as MRS. WATSON SMITH.

L.C.P

Oct. 2 – Mejirirrik I. (Elizabeth)
Aspect in village not strikingly different from pre-typhoon appearance – trees and cultivated plants generally young.
Plants seen:

pl.o Plumeria rubra
pl.o Polyscias scutellaria
c Premna obtusifolia
a Pandanus tectorius
pl.o Nerium NERIUM (sprouting from stump)
pl.c Musa sapientum
pl.a Cocos nucifera
a Fimbristylis cymosa
pl.c Artocarpus altilis
c Morinda citrifolia
a Polypodium scolopendria
a Lepturus repens
l a Nephrolepis acutifolia
BRUGUIERA
l a Bruguiera gymnorhiza
CARICA
c Carica papaya
pl.c Cucurbita pepo ? (round fruit, spotted lvs.
pl.r Xanthosoma sagittifolium (chlorotic)
o Tacca leontopetaloides
ELEUSINE
l c Cleusine indica
l a Triumfetta procumbens
c Pteris tripartita
CENCHRUS
l c Cenchrus echinatus.
ERAGROSTIS
l a Eragrostis amabilis (in paths)
pl. Alocasia macrorrhiza (planted)
(lvs very erect. The angle with blade.)
a Vigna marina
pl.r Codiaeum variegatum (T.n. 71-73)

1960 Marshall Is.

Jabor Islet Jaluit Atoll

Oct. 21 – Jabwor

41383 Stachytarpheta urticifolia
13 one plant in open herb flat

1 84 Hemigraphis reptans (Forst.) And.
rare around old masonry ruins.

MEJURIREK

Oct. 22 – Mejirirork (Elisabeth) I.
~~near r just below high~~

1 85 alga ♂
~~near~~ just below high tide level in tidal pond.

1 86 (alga)
epiphytic on Pemphis trunk near high tide level around tidal pond.

1 87 moss
88 moss
same

Oct. 22 – Jaluit Islet

1 89 (fungus) Daedalea elegans Fr. E.R.
on rotting coconut trunk

4 90 Lumnitzera littorea
locally abundant in swamps.

6 91 Sonneratia alba
locally common in swamp

2 92 Vittaria incurvata Cav.
rare, epiphytic on tree trunk in moist forest.

get it to use quickly. Address it to me as MRS. WATSON SMITH.

---

branched herb to 0.8 m. tall,
— flowers deep purple.
prostrate; chlorotic.

tree 4 m. tall (others taller);
leaves sub-fleshy to leathery;
— flowers scarlet "kimeem"
tree 6 m. tall, spreading
(others erect, to 10-12 m. tall);
petals linear, white,
stamens white "pulabl"
= sweet nectar from flowers
eaten by Marshallese.

1960 Marshall Is. -

Several young coconut trees (nuts from Majuro) the leaves, after the first 2 or 4, not completely opening up - pinnae adhering at margin, separating along midrib. 3 seen in immediate area of village. Many other seedlings normal.

In coconut groves the general ground cover - mostly Lepturus, is complete. Much Fimbristylis. Patches of Nephrolepis hirsutula, scattered Pteris tripartita + clumps of Polypodium. patches of Triumfetta

Many young breadfruit trees planted, some volunteers. about 3-5 m. tall. expected to produce fruit in from 6 to 11 years.

Many small bushes of Morinda, Premna, scattered in coconut grove. Mostly appearing to be from old cut stubs, possibly from clearing for coconut planting.

Bananas bearing, look healthy except occasional slight chlorosis.

get it to use quickly. Address it to me as MRS. WATSON SMITH.

Plants seen (ctd.)

r Pseuderanthemum carruthersii
lc Digitaria pruriens v. microbachne
ra Cassytha filiformis
ra Wedelia biflora
ro Euphorbia chamissonis
la. Fleurya ruderalis
l Portulaca oleracea
lo Guettarda speciosa
lc Scaevola sericea
r Allophylus timoriensis
lo Cordia subcordata
r Terminalia samoensis
r Asplenium nidus
r Calophyllum inophyllum
r Procris pedunculata
l. Pemphis acidula
l Pipturus argenteus
l Peperomia ponapensis

Patches of pumpkins planted, also small patch of Alocasia. Some Pandanus planted for food. Volunteer Pandanus used for hats + mats.

On n. ~~end~~ side of islet near passage to e. Polypodium, Cassytha, Triumfetta, Nephrolepis abundant in ground cover. Some Euphorbia, Wedelia, Digitaria, Fleurya, Fimbristylis, aspect drier.

~~Wedelia generally not abundant.~~ ~~a~~ Fleurya in rocky places ~~except on the passage side~~

1960 Marshall Is.

photos in open area back of lake, filled with Wedelia. also in area of young coconuts and across lake, all from same spot. (low tide)

Patch of Pemphis around edges of lake.

Algae not conspicuous in lake as before, but still present.

Seedlings of Pemphis and Bruguiera abundant around margins of lake, none in lake bottom, though it is almost dry at low tide (photos)) –

Wedelia is abundant and forms blankets in open areas toward seaward side, especially near east passage.

planted before typhoon

In semi-open area back of lake, with coconut trees with trunks 1–1.5 m. tall, Polypodium Lepturus and Cassytha most abundant. Cassytha thickest in opener spots. Seedling Morinda common here.

Cordia trees ~~[illegible]~~ occasional along beach ridge, not inland, no seedlings. Guettarda not common inland from sea or passage.

[illegible]

Jaluit

There are still many coconut trunks lying on ground, some rather well rotted, others still firm, but in general rather well cleared away where they formed an obstruction.

Back of Pemphis zone back of lake in open area generally covered by Wedelia are coppice-like clumps of seedling Guettarda, possibly cut off once but abundantly sprouting, about 1.5–2 m. tall. (photos)

? many

photos

Palaemon (Palaemon) debilis Dana

Bottom of lake hard, pan-like, level, marly, but with pits near center with water at low tide – shrimp.

No mud except very near edges around mangrove and Pemphis patches. (sample 12)

On old gnarled Pemphis trunks epiphytic algae, mosses, Nephrolepis acutifolia, [illegible] Polypodium. On older Bruguiera epiphytic Nephrolepis acutifolia, large clumps.

1960 Marshall Is.

On n.w. corner, even in rather open areas, are Wedelia, Polypodium & Nephrolepis & seedling Pandanus form principal ground cover, sparse 0.5 m.± tall with Triumfetta. Fimbristylis, Lepturus. Fleurya. Polypodium, Nephrolepis, seedling Tournefortia on beach ridge (sharp gravel). Scaevola seedlings just above reef flat.

In areas with semi-closed cover of coconuts of various sizes, a luxuriant tall ground cover of Polypodium and Nephrolepis about 1 m. tall.

Large black skink seen

On ~~n.w~~ n.w corner is a patch of thicket with tall coconut trees, 5 coppice like Pipturus to 4 m. considerable shrubby Allophylus, much Asplenium and Procris, Peperomia, etc. growing on deposit of large sharp boulders. Ferns luxuriant. Int Some shrubby Intsia bijuga, Morinda. This area is a boulder tract perh

1 m. above general level of island.

Just inside this is park-like coconut grove, Lepturus forming dense ground cover, seedling Intsia, clumps of Nephrolepis on fallen coconut butts.

Surrounded by thickets of Pipturus, Morinda, Pemphis, Pandanus seedlings. Small Bruguiera depression, this filled with rotting coconut husks, probably left by typhoon. Pandanus trunks pretty well rotted. Coconut trunks mostly still rather firm, but bark coming off.

Southeast corner rather open, several well formed young breadfruit, a few ragged Pandanus, one or two large old breadfruit trees. scattered coconuts. general dense ground cover of Vigna, this rather chlorotic (photos). One small patch of Wedelia (dark green).

1960 Hernandia sonora

Plants seen (ctd.)

lc Intsia bijuga
lc Thuarea involuta
pl.o Crinum procerum
pl.o Mirabilis jalapa
pl.r Hippeastrum puniceum
pl.r Catharanthus roseus
pl.r Tagetes
r Physalis angulata
pl.r. Zephyranthes rosea
Asclepias curassavica (in leis
Polyscias fruticosa (in leis)

Coconut planting has been fairly general, regardless of whether there were trees not damaged by typhoon, except for very young ones.

Several turnstones on bottom of pond.

2 reef herons one white, one almost white.

Flock of white-capped noddies in lagoon

Several white terns inland

Jaluit.

Smaller islets on south reef, mostly have a tangle of scrub with a few coconut trees, none of these very tall. Much of tangle, at least on lagoon side, seems to be Scaevola.

Larger islands mostly well covered by coconuts, some leaning at odd angles, but mostly looking rather normal.

Considerable sand on lagoon sides.

Bokan - islet nearest Jaluit I. seems to be 3 small islets joined together - rather few coconuts except on west end. These on east end rising through irregular thickets of small trees and shrubs.

Reef between islets very wide, inner slope rather steep, covered with rubbly debris. Opposite islets more sandy, gently sloping, much live coral in shallower parts.

Wide shallow area opposite Jaluit I.

Oct. 22 – Jaluit I. e. end.

Plants seen
Pandanus tectorius
Cocos nucifera
Plumeria rubra
Carica papaya
Lepturus repens
Musa sapientum
Cucurbita
Mirabilis jalapa
Hymenocallis littoralis
Crinum asiaticum
Artocarpus altilis
Zephyranthes rosea
Phyllanthus amarus
Gomphrena globosa
Euphorbia hirta
Eleusine indica
Thuarea involuta
Digitaria pruriens
var. microbachne
Cenchrus echinatus
Wedelia biflora
Alocasia macrorrhiza
Polypodium scolopendria
Tacca ~~pi~~ leontopetaloides
Nephrolepis hirsutula
Vigna marina
Pemphis acidula
Clerodendrum inerme
Fimbristylis cymosa
Triumfetta procumbens
Scaevola sericea

Tournefortia argentea
Bruguiera gymnorhiza
Pipturus argenteus
Guettarda speciosa
Fleurya ruderalis
Asplenium nidus
Nephrolepis acutifolia
Vittaria elongata
Pisonia grandis
Allophylus timorensis
Lumnitzera littorea "kinnen"
Sonneratia alba "palal"
Morinda citrifolia
Vigna marina
Cassytha filiformis
Centella asiatica
Blechnum pyramidatum
> Cyperus javanicus
pt. Crinum procerum
Calophyllum inophyllum
Portulaca oleracea
Terminalia catappa

Several golden plovers inland
1 whimbrel in swamp
1 white tern in swamp

East of village a low completely bare irregular area showing signs of flowing water, drain from swamp?.

West of this is an area of an acre or two where all the coconut trees have been cut down - even apparently healthy rather young ones - in order to let in sun for the newly planted young ones. (photos b&w) A few tall Pandanus left standing. Surrounded on one side by Pemphis forest. The Pemphis forest is really a tidal swamp irregular, mostly about 5 m. tall. no undergrowth at all. Bare coarse sand as in adjacent open bare flats. In these some old Bruguiera but most of this was apparently destroyed by the typhoon. (photos b.w)

~~West~~. East of this a rather extensive ~~[illegible]~~ strip of clumps of Pemphis ~~[illegible]~~ sprouts about 2-3 m. tall, open. Then a large area that was Bruguiera swamp, but all old trees

removed by typhoon - root and knee systems remaining. Much of this now covered by young Bruguiera saplings 1-3 m. tall! (photos b&w. kod.

Between this and beach a sheet of coarse gravel perhaps 200 m. wide with a few standing coconuts, many fallen ones. Open stand of young clumps of Tournefortia and Scaevola about 1 m. tall or less. Planted to coconuts. Some patches of Lepturus, some Triumfetta inland from beach a few mats of Wedelia. (photos - kod. b&w)

This gravel sheet swept into edge of mangrove swamp, margin buried, about 0.3 m. thick here.

Trees here have fallen either east or west or generally ~~that~~ both ~~[illegible]~~ of these direction

Considerable acreage of Bruguiera saplings, a few old trees left in s.e. corner of swamp.

Wedelia is abundant toward s.e. corner of islet, outside swamp. Aspect here generally wetter, more luxuriant. Asplenium large, Pipturus common. epiphytes common.

On south side of swamp Lumnitzera is common, and 2 trees of Sonneratia. Much of this swamp is hard bottomed, some covered by small broken coral debris.

In this area Lumnitzera is locally dominant in swamp.

Not much damage here by typhoon.

This area of swamps, tidal flats, localized higher ground extends westward through middle of islet. Locally Sonneratia is abundant, with some Bruguiera, Lumnitzera, Pemphis. Locally Bruguiera & Pemphis more abundant. Pemphis usually on slightly higher ground.

One area between swa and lagoon almost treeless, grassy.

Back of lagoon ridge in places are marshes, mostly dominated by Cyperus javanicus.

Pandanus not at all abundant on this islet.

Long Islet.

On arcuate gravel bar along lagoon shore, interrupted a few scattered ~~[illegible]~~ young Scaevola, Tournefortia, 2 Cocos seedlings.

One white reef heron.

Pemphis abundant along lagoon shore – clumps of sprouts.

Oct. 23 Emybor I.

Plants seen.

lc Artocarpus altilis
la Cocos nucifera
c Morinda citrifolia
c Pandanus tectorius
c Pipturus argenteus
a Wedelia biflora
la Vigna marina
lc Asplenium nidus
lc Physalis angulata
la Pemphis acidula
r Alocasia macrorrhiza
o Polypodium scolopendria
r Kalanchoe pinnata
la Lepturus repens
r Allophylus timoriensis
r Pisonia grandis
o Guettarda speciosa
la Hibiscus tiliaceus
lc Scaevola sericea
r Calophyllum inophyllum
lc Premna obtusifolium
c Tournefortia argentea
lc Fleurya ruderalis
l Portulaca oleracea
lc Phyllanthus
l Cyperus javanicus ✗
lc Fimbristylis cymosa
l Digitaria pruriens v. mur
r Cassytha filiformis
r Tacca leontopetaloides
lc Thuarea involuta
r Cenchrus echinatus
r Eleusine indica

Small flock of common noddies on old tree skeleton near wrecked pier and generally flying around passage end of islet.

Grove of breadfruit trees perhaps 20-22 cm dbh. broken off part way up by typhoon - almost all have sent out vigorous sprouts from upper part of trunks and formed full-crowned well-formed trees, now flowering.

Ground cover generally Wedelia, locally Vigna. Has been cleared out some time ago.

Some of Breadfruit trees nearer sea have not recovered, are completely dead.

Lined skinks abundant.

Wedelia seedlings in great abundance, especially where there is decomposing trash, and on rotting branches.

Pipturus sprouting vigorously from stumps where trees have been cut during clearing. Uncut trees commonly 5-8 m. tall.

Many of sprouts chlorotic. These heavily infested with red mites. (coll.) Aedes abundant (coll.)

In the pass between Enybor and Kabbenbock is a Y shaped reef with very long arms, the right one perhaps ½ m On it are a number of very large boulders, and much large rubble.

A reef patch in the right hand channel about even with the in end of the above branch of the Y shaped reef.

These all bare at low tide. ~~a cons~~

A considerable number of large volcanic boul from wreck on Kabbenbock here around landing, probably brought by people.

Dense thicket ~~Clumps~~ of Hibiscus tiliaceus, some around ~~a~~ small ponds, some not. Certai branches very chloroti mostly normally gre (photos taken)

Most of the area of this islet has been almost completely cleared, except clumps of Pemphis, Tournefortia, occasional breadfruit tr Covered mostly by a blanket of Wedelia.

One area has had the Wedelia chopped away, rolled up and burned recently. Here the gravelly dark gray soil is being colonized by millions of seedlings of Wedelia.

Many bomb craters filled with water, green with microscopic algae.

Several white terns flying around, mostly near Hibiscus thickets.

Common noddies by far the most frequent birds.

Many young coconut trees, from before typhoon, along pass and lagoon sides.

~~Hiss~~ The cleared area has been staked out for planting coconuts but very few have been planted.

On sand flat protruding into lagoon are seedlings of Scaevola, Tournefortia, Triumfetta, Pandanus, Wedelia, Lepturus, Vigna, Ipomoea pescaprae (chlorotic)

Plants seen (ctd)
Pl. d. Pseuderanthemum carruthersii
l. Hernandia sonora
" Sophora tomentosa
l Ipomoea pes-caprae
Terminalia catappa
Caesalpinia ~~major~~ bonduc
Musa sapientum
Lumnitzera littorea

1 reef heron and 1 tattler seem to be
companions, when one flies or alights, other d
-1 white. 1 white with black wing pa
1 white heron, 1 blue, 1 ~~blue~~
gray with white shoulder patch (lagoon reef flat)
Several wandering tattlers
on seaward reef flat
1 turnstone on lagoon beach

Young coconut trees
seem mostly decumbent
at base, then erect.
On lagoon shore many
small Rattus exulans
running around in broad
daylight, scarcely afraid
of humans.

On narrow part of islet
is a long masonry stone wall
about 0.7 m. high running from place where
islet narrows almost
to first cluster of buildings.
On seaward side gravel is
piled against it part
way, no vegetation.
On lagoon side a narrow
reef platform strip with
a slight accumulation
of sand at lagoon edge.
Thin vegetation of Vigna,
small Pemphis wisps,
small ~~[illegible]~~ Tournefortia
bushes, small Scaevola, Ipomoea pes-caprae seedling
coconut seedlings, a few
Pandanus seedlings. Some
Lepturus, esp. on sandy places,
but also on bare rock, Triumfetta
A few larger coconut trees
a few Hibiscus seedlings.
Much bare rock.
Beyond end of wall no veg. on
bare eroded platform (except 1 small
Tournefortia) until clump of buildings.

at end of sea wall the platform rock is eroded, a few scraps of upper surface left. this indurated, below this merely compacted - firm but crumbles easily when hammered. Black with algae. Topmost parts of this platform must be 3 m.? above l.t.

sample #13 - indurated flat surface

sample #14 - softer material below.

sample #15 - hard material from rough surface of seaward erosion ramp cut in coarse platform breccia

Breccia

Oct. 23 Jabwor

Terminalia catappa fairly well leafed out in sprouts all over old trunks and broken branches. a few Pandanus with big tufts of leaves on branches that were not broken. No sprouting from broken branches.

Fairly extensive sweet potato patches that look pretty good along main street north of radio station.

8.15 - Along path

a Euphorbia prostrata
a Phyllanthus amarus
la Vernonia cinerea
a Euphorbia hirta
a Pilea microphylla
Centella repens
c Cyperus rotundus
o Portulaca oleracea
c Synedrella nodiflora
lo Crotalaria incana
a Stachytarpheta urticaefolia)
a Blechum pyramidatum
c Cyperus pennatus
la ~~biflora~~ Wedelia biflora
lo Eragrostis amabilis
c la Leucaena glauca
~ Cyperus compressus
o Eleusine indica
s. Hedyotis corymbosa

a Euphorbia thymifolia?
a Hedyotis biflora
a Digitaria a
a Euphorbia [illegible]
c Digitaria pruriens v. microbachne
c Ageratum conyzoides
c [illegible]
Physalis angulata
[illegible]
sc
s

Ornamentals
Lantana camara carruthersii
Pseuderanthemum carruthersii
and var. atropurpureum
Zephyranthes rosea
Plumeria rubra
Hymenocallis littoralis
Mirabilis jalapa
Zinnia elegans
Catharanthus roseus
Gomphrena globosa
Ocimum sanctum
Canna hybrid

Ageratum, very rare before, now common on distal part of islet. Cyperus rotundus, observed as a small patch in village, now scattered around trails fairly generally. Crotalaria still very common but by no means as much s as before - largely crowded out by Wedelia. Blechum very abundant, especially where Wedelia has been cleaned out.

Terminalia, Hernandia, Calophyllum, Artocarpus, Ficus, have recovered very well, filling out crowns with sprouts (except Artocarpus when too damaged, then it died).

In old botanical garden
Epipremnum pinnatum
Cycas circinalis
Ficus elastica
Delonix regia
Erythrina variegata
Scindapsus Scindapsus aureus
Sansevieria roxburghii
Cassia occidentalis
Hibiscus tiliaceus
Calophyllum inophyllum
Samanea saman
Rhoeo spathacea
RHOEO

Distal part of island almost completely cleared, covered by a clipped weedy growth of Blechum, Stachytarpheta, Leucaena, Vigna, etc. about 2-3 dm high. Widely scattered trees - Carica, Terminalia, Artocarpus, Pipturus, Pandanus, Musa, Hernandia,
STACHYTARPHETA

2 whimbrels flew up near radio station, heard a bristle-thighed curlew.

1960 Marshall Is.

Oct. 23 – Enybor Islet

41393 Caesalpinia bonduc (L.) Roxb.
2 single plant on narrowing part of islet in deep tangled Wedelia

9 94 Phyllanthus amarus Schum. & Thonn.
abundant in recently disturbed places

6 95 Hernandia sonora L.
occasional

2 96 Pandanus tectorius
common

Oct. 23 – Jabwor
in waste spots and along paths

2 97 Dentella repens
abundant along paths

3 98 Hedyotis corymbosa
abundant along paths

2 99 Euphorbia thymifolia L.
very local in path

41400 Cyperus kyllingia
2 very local along trail

2 01 Digitaria pruriens var. microbachne
very local in trail

1 02 Euphorbia prostrata
very common in trail

5 02a Euphorbia glomerifera (Millsp.) Wheeler
locally abundant

Oct 25 Long Islet bet. Sydnetown and Lelut

1 03 Hibiscus tiliaceus
rare seedlings on bare gravel

1 04 seedling

Jaluit Atoll

young plant three vine-like branches 1–2 m. long; sterile.

sprouting fallen tree; fruiting envelope inflated, orifice not toothed at all.

tall trees; fruits on ground.

prostrate, forming a mat, corolla pale dull blue, lobes with white margins.

prostrate, forming a mat, corolla white.

stems and leaves green, flowers whitish.

heads white

(Presl) Fosb. culms spreading.

whole plant purple.

erect

Oct. 24 – Long Islet, bet. Jabwor and Jaluit.

In the area where the ridge of boulders on the seaward reef flat (b.w. photo) has disappeared, at low tide it becomes obvious that it has largely just spread out and become a rubble tract.

On lagoon reef flat there is a broad flat strip of gravel separated from the land-strip by 30 to 100 m. On the surface of this blackened rather stable mass is a ridge of smaller material, obviously more washed, whiter, forming a photos sharp-topped bar ridge.

This is more or less the situation the length of this strip between Jabwor and Jaluit.

Seedling of Calophyllum deeply rooted, healthy, in bare gravel sheet.

Pemphis forest – bare trees still standing, trunks

sometimes sprouting, clumps of sprouts up to 1-1.5 m. tall at bases (photos).

Just north of Sydneytown an area of low platform awash at high tide quite abraded. ~~Ou~~ Inside this the lagoon bar is missing. Outside, the gravel ridge on the reef flat is still mostly separated by 15 m. or so of water from the land strip. This ridge is at least 2–2.5 m. high in places, quite abrupt on inner side, imbricated slabs on outer side. (photos)

This outer ridge is lacking opposite Sydneytown but a sharp ridge is piled up on the outer edge of the land-strip just n. of Sydneytown.

Several wandering Tattlers on outer reef flat.

On lagoon reef flat opposite a cut through the breccia platform is an arcuate inner gravel gravel bar, inside the main one. (photo – kod.)

The end of the main outer bar here is just opposite the cut in the breccia platform and is rounded, imbricate seaward around the end, ~~[illegible]~~ and the opposite side of the cut is swept very clean, suggesting that the currents or waves come through this channel from a dominantly n. e. direction, exerting their force against the south side of the channel, and arranging the gravel slabs on the lobe of the ridge in imbricate fashion with less energy involved, thus not carrying this loose material along into the lagoon.

Channel ~~sh~~ dug across land strip by Japanese south of Sydneytown in three layers, successively harder downward (photos - b+w), samples 17, 18, 19 (downward).

To lagoon side of this is a circular debris bar, surrounding a pool. (photos), this immediately

lagoonward of shore, a broad reef flat ~~[illegible]~~ lagoonward of this, then a well developed bar on lagoon edge of this. The flat well strewn with large boulders.

Seaward the boulder ridge is separated from the erosion ramp, and here, for a ~~[illegible]~~ distance of perhaps 100 m, loops out away from ~~[illegible]~~ shore and is higher than in either direction, where it is spread out and low.

South of here a very low strip, about 100 m. w., scoured off except for remnants of an old breccia platform. Lagoonward is a concentration of debris - a high crowded place in the debris ridge (photos - b+w, & a number in several directions. Seaward from this wash another loop of high ridge, again extending a bit south of breach in land strip.

South to here on land strip from Sydneytown vegetation mostly a low irregular scrub of Tournefortia and Scaevola. Pemphis on seaward lagoon veg. front. Southward same but much lower and thinner. (photo)

Enormous boulders thrown upon lagoon slope of lagoon ridge, up to 2×2×3 m. but irregular. Many of them, this the largest. Some are large Millepora colonies, most are very complex. A few of these are erosion remnants of a former platform. This lagoon ridge, here is broad and thin and lies on a planation surface that is much like an erosion ramp, sloping slightly lagoonward. Sample 10 is from top of seaward edge of this. (Photo showing er. remnant on left, boulders on it.) Just beyond, a breach in landstrip, showing that the reef flat (i.e. a broad erosion ramp) continues under the consolidated debris ridge to lagoon side. much denser and harder than the material lying on it. On this dissected partially consolidated material there are old stubs of Pemphis on lagoon side. Young plants of Tournefortia and Scaevola making

up an open scrub. with ~~a few~~ ~~some~~ small mats of Triumfetta. Seedlings of Scaevola, Tournefortia, Pemphis, Cocos, Vigna, Hibiscus tiliaceus, Barringtonia asiatica, Pandanus (in loose debris).

Two white terns flying.

Pemphis, Scaevola, Lepturus, Tournefortia, Cocos, Fimbristylis can clearly grow where inundated by very high tides.

More vegetation on higher spots, also larger Tournefortia and Scaevola plants. Patches of Triumfetta.

Photos of broad erosion ramp and rubble tracts on seaward reef flat, also of scrub on debris ridge on landstrip beyond small concrete building, toward warehouses.

On debris ridge seedlings of Guettarda, ~~of~~ Canavalia, Barringtonia, Cocos. Scrub of Tournefortia + Scaevola 1-2 m high. Ipomoea tuba in it. Young coconuts.

Sharp ridge near lagoonward edge of lagoon reef flat — being colonized by Pemphis, Ipomoea tuba, Cocos, Scaevola, Vigna, Hibiscus tiliaceus Tournefortia seedlings. Pandanus fruits thrown up but not seen germinating

Wide place at warehouse with open scrub of Tournefortia, Scaevola, Pipturus, a little Allophylus, patches of Wedelia, occasional Premna + Allophylus.

some dense residual scrub of ragged Pandanus, Pisonia, Guettarda, Tournefortia, Coconut.

This area seems to be a large gravel sheet laid down by the typhoon, the residual vegetation not quite buried. Most of the rest representing colonization. Surprising thing is number of bushes of all sizes of Pipturus. Some of the smallest ones seem to be drying up, but mostly not

Here a sheet of very rounded flat gravel extends from the land strip out onto the lagoon reef flat with a lobed margin.

Much open ~~[illegible]~~ bare gravel between bushes, but some large mats of Wedelia, Vigna, Triumfetta, Canavalia and Ipomoea pes-caprae (thin) Some small patches of Fimbristylis.

Reef herons seen — 3 white, 1 blue, 2 white with some gray.
1 whimbrel.
1 reef heron chasing or playing with a tattler.

Beyond warehouse we went by boat. Generally the vegetation is a strip of ~~often~~ sparse and irregular scrub, mostly Tournefortia, on platform and debris, with sparse Pemphis on denuded flats & erosion ramp.

Standing coconuts very few around warehouse, even fewer down the land strip, then becoming

slightly more abundant
till we come to a wider
place, where a considerable
number are left standing.
Here at this wide place,
a high [illegible] gravel ridge along lagoon
shore, and on beach of this
huge coral blocks scattered.
2 whimbrels here.(?)
Here the gravel ridge
has mostly moved
onto the shore, making
a typical boulder ridge,
but to north it is still
a bit separated.

On the flat is an
open to closed scrub of
Tournefortia. some Scaevola
some Guettarda, many
stunted seedling coconuts,
incomplete groundcover
of Triumfetta, some
Ipomoea tuba, some
Pandanus seedlings.
some Canavalia. Standing coconuts sparse
Part of this that was
scoured by typhoon
is pretty well vegetated,
with even some residual
sprouting Guettarda, etc
Part covered by gravel
sheet has scattered
bushes of Tournefortia.

Scaevola up to 2 m. tall.
417 Lagoonward these become
smaller, up to 0.5 m.
Pemphis seedlings and
clumps of sprouts on
hard rock near lagoon,
some curved gravel bars
near lagoon shore, being
colonized by Pemphis,
Lepturus, Tournefortia,
Scaevola, Pandanus(s.)
Wedelia(n.s.), the plants
up to 1 – 1.5 m. tall
Pandanus trunks on ground rotten.
Southward a similar
scrub, with scattered
standing coconut trees continues,
becoming lower and more
sparse in places, the
Pemphis along the lagoon
varying from dense to
absent, always principally
on bare erosion ramps
or platform rock.
Many bare Pandanus
trunks still standing.
Lagoon bar discontinuous,
high in places.
One stretch of it has
many great boulders
strewn on its lagoon slope.
Clearly from lagoon bottom.

Oct. 24 Jabor -
Photos (b & w kod.) of trees along lagoon shore of Jabor.
1 blue, gray & white reef heron on end of Jabor.

Oct. 24 - Enybor -
photos - b+w, kod. of recovered breadfruit trees on n. w. corner of islet.

Oct. 25 - crossing lagoon Jabor to Pinlep - one brown booby flying over lagoon. returning in evening 4 brown boobies.

Oct. 25 - Pinlep
Plants seen
la Lepturus repens
lc Cassytha filiformis
l Centella asiatica "manilo"
c Triumfetta procumbens
c Thuarea involuta
c Pandanus tectorius
la Digitaria pruriens v. microbachne
a Cocos nucifera
lc Carica papaya
a Vigna marina
la Phyllanthus amarus
o Cenchrus echinatus
lc Eleusine indica
la Euphorbia hirta
lc Eragrostis amabilis
c Artocarpus altilis
pl Catharanthus roseus
pl Crinum procerum?
pl Musa sapientum
a Wedelia biflora
lc Tacca leontopetaloides
a Pipturus argenteus
la Fimbristylis cymosa
la Euphorbia prostrata
pl Cucurbita pepo
pl Plumeria rubra
p.l? pl Gomphrena globosa
lo Synedrella nodiflora
c Morinda citrifolia
lc Portulaca oleracea
pl Zephyranthes rosea
la Pilea microphylla
Pilea

pl	Asclepias curassavica
c	Fleurya ruderalis
lc	Paspalum conjugatum
a	Nephrolepis hirsutula
a	Polypodium scolopendria
pl	Ocimum sanctum
	~~Asclepias curassavica~~
c la	Scaevola sericea
la	Tournefortia argentea
pl	Tagetes
pl r	Hibiscus mutabilis
l	Clerodendrum inerme
pl	Hymenocallis littoralis
pl	Crinum asiaticum
pl	Polyscias tricochleata (chlorotic)
lc	Allophylus timoriensis
lc	Calophyllum inophyllum
c la	Asplenium nidus
lc	Ipomoea tuba
lc	Guettarda speciosa
r	Terminalia samoensis
r	Boerhavia Tetrandra
lc	Intsia bijuga
VITTARIA r	Vittaria elongata
lc	Nephrolepis acutifolia
la	Eleocharis geniculata
c	Alocasia macrorrhiza
lc	Hibiscus tiliaceus
la	~~Bo~~ Thelypteris goggilodus
r	Ophioglossum pendulum
r	Pteris tripartita
pl	Codiaeum variegatum
pl	Acalypha wilkesiana
pl	Pseuderanthemum carruthersii var. atropurpureum

Pipturus trees that are chlorotic have very few red mites.

Zoysia tenuifolia supposed to ~~be~~ have been brought from Jabor, to which it was introduced by the Japanese.

Monarch butterflies and larvae abundant around milkweed patch in village.

~~Ea~~ north part of islet brushed out for planting in December.

Whimbrel on ~~day~~ pass reef.

White-capped noddie.

8/19

Mangrove swamp near north end almost clear. Scattered clumps of very slender Bruguiera to 5 m. tall. Many seedlings. Has been cleared somewhat to plant coconuts. Many volunteer coconut seedlings. Many fallen and standing trunks covered by epiphytic ferns. This cleared swamp is adjacent to an open-water pond, strongly brackish, great masses of blue-green algae of a muddy yellow-green color. Apparently rather little tidal fluctuation. A few big Bruguiera around pond, some saplings, mainly coconut seedlings. Eleocharis in mud back from edge. Coconut seedlings somewhat or very chlorotic.

Much trash in pond. ~~One~~ several fish about 20-25 cm. long, mud color with black fins, yellow tail, mullet shape.

Several white terns, one or two tattlers. White capped noddies. ~~and~~ golden plover.

Red Libellula, large. one or [illegible] common noddies? Big greenish Aeschna, Gomphus

Large area of this swamp, mostly semi-open. Around this, especially southward, is a tall scrub or low forest of Pipturus argenteus, slender, 5-6 cm. dbh maximum, to 4-5 m. tall. Has been cleared beneath. Varies from soil of some depth to boulder field. Ferns abundant.

In interior are considerable open areas or with scattered breadfruit trees, covered by a blanket of Wedelia.

o Premna obtusifolia
pl Polyscias scutellaria
pl r Citrus aurantifolia
e Euphorbia chamissonis
e Cyperaceae javanicus
eo Cyperus compressus
o Physalis angulatus
eo Ipomoea littoralis
ea Cyperus odoratus
CYRTOSPERMA
pl e Cyrtosperma chamissonis
pl r Colocasia esculenta
? pl ec Jussiaea suffruticosa
c Canavalia microcarpa

Other areas have grown up to the low forest type dominated by Pipturus. In places this is cleared out locally. Some areas the average height is 6-8 m.

The breadfruit trees injured by the typhoon either died or have recovered remarkably well, branches as large as 10 cm diam. have grown since the storm, crowns well filled out, symmetric. Leaves dark green. Some infestation of cottony cushion scale. Some trees have died of a peculiar disease. (Knudsen described it in report to Hi Com.)

Taro pit - generally dominated by Thelypteris goggilodus, locally by Cyperus odoratus or Echinochloa, locally invaded by Pandanus, Vigna, etc. Jussiaea common. Very little taro cultivation - two rows and scattered plants of Cyrtosperma, scattered small patches of stunted Colocasia.

In other pit Thelypteris even more generally dominant, almost exclusive over much of the area. Small patches of Eleocharis, Ipomoea tuba, open water with blue-green algae. Some invasion by Pandanus. Occasional Jussiaea. No Echinochloa. Only a very small part of this pit occupied by Cyrtosperma, no or very little Colocasia.

Of total area of two pits perhaps not more

than 1% occupied by either taro. Only a few sq. m. cultivated - Cyrtosperma.

Aedes common.
Wedelia blankets all openings in this vicinity, incl. margins of taro pit.

Paspalum conjugatum is very locally common along trails in semi-shade, nowhere really abundant.

Mangrove swamp between taro pits and village has all larger Bruguiera trees dead and broken off part way up. Ascribed to typhoon.

Many well grown seedling coconuts generally.
Pandanus trunks mostly rather well rotted, coconut less so.

Along seaward side a well-developed Scaevola fringe 2-3 m. tall.

Epiphytes common to abundant on older trees in interior.

1940 Marshall Is.

PINLEP
Oct. 25 - Pinglap Islet,

41405 Thelypteris gongylodes
8 dominant in semi-abandoned taro pit.

r6 06 Jussiaea suffruticosa
common in semi-abandoned taro pit

3 07 Echinochloa crusgalli (L.) Beauv. sens. lato
locally dominant in semi-abandoned taro pit

2 08 Zoysia tenuifolia
locally planted in home yards of in coral gravel

2 09 Ophioglossum pendulum L.
rare, epiphytic in wet forest

Oct. 26 - Kinajon I.

1 10 Allophylus timorensis Bl.
common in dense scrub on gravel beach ridge.

1 11 Entada ? pursaetha DC.
one plant on beach ridge.

IMROJ
Oct. 26 - Imroj I.

4 12 Vigna marina (Burm.) Merr.?
abundant on new gravel

8 Oct. 28 - Ribon I.

7 13 Vittaria incurvata Cav.
rare, epiphytic on tree trunks

erect from rhizomes buried slightly in mud.

herb 1 m. tall, branched; petals 4, yellow; caducous.

— erect.

forming a close dense mat.

sterile

large shrub 4 m. tall, seedlings abundant beneath

— it.

seedling

unifoliolate

prostrate, sterile; note unifoliolate leaves, these seem to be characteristic of rapid-growing shoots at least ~~so~~ in this area.

Oct. 26 - trip Jabwor to Imroj
Crested tern flying over lagoon.

Oct. 26 - Imroj Islet
Plants seen

pl Gomphrena globosa
a Polypodium scolopendria
pl Plumeria acutifolia
c Carica papaya
pl a Musa sapientum
pl Zinnia elegans
pl Mirabilis jalapa
a Cocos nucifera
pl Asclepias curassavica
c Pisonia grandis
pl a Citrus aurantifolia
pl a Hibiscus hybrid (very [illegible])
pl a Cordyline terminalis
pl Cucurbita 2 sp.
a Centella asiatica
pl a Ipomoea batatas
pl a Cucumis sativa

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bc Barringtonia asiatica
c Physalis angulata
c Morinda citrifolia
pl ~~Alocas~~ Xanthosoma sagittifolia
la Tournefortia argentea
c Eleusine indica
c Artocarpus altilis
la Digitaria pruriens v. microbachne
c Pandanus tectorius
la Pipturus argenteus
c Alocasia macrorrhiza

Bananas very luxuriant around house.
Centella is remarkably abundant on gravel sheets in full sun.
Young Tournefortia 2-2.5 m. tall.
Sweet potato patches very common.

Phosphate bed covered by an open scrub of Pipturus with some areas closed, some Clerodendrum, much Lepturus and Digitaria filling interstices. Fleurya and Polypodium prominent on rocks, here and there Wedelia mats, a little Nephrolepis.
Toward the pass this becomes locally closed, 3 m. tall, and composed of Scaevola, Tournefortia, Guettarda, Barringtonia (from old stubs) Thuarea and Lepturus in openings.

Two former mangrove depressions at north end - one is completely bare, the other has many Bruguiera seedlings and a few larger but still small plants.
1 grayish mottled reef heron

Plants seen (ctd.)

pl	Crinum asiaticum
pl	Hymenocallis littoralis
pl	Polyscias scutellaria
o lc	Cenchrus echinatus
la	Lepturus repens
pl	Angelonia angustifolia angustifolia?
pl	Catharanthus roseus
pl	Zephyranthes rosea
la	Fimbristylis cymosa cymosa ?
a	Vigna marina
lc	Hedyotis biflora
o	Calophyllum inophyllum
la	Scaevola sericea
o	Eragrostis amabilis
c la	Fleurya ruderalis
lc	Thuarea involuta
a	Wedelia biflora
c la	Triumfetta procumbens
lc	Clerodendrum inerme
lc	Nephrolepis hirsutula
c	Guettarda speciosa
r	Peperomia ponapensis
r	Euphorbia chamissonis
pl.	Codiaeum variegatum
c	Allophylus timorensis
la	Bruguiera gymnorhiza
lc	Kalanchoe pinnata
r	CAESAL Caesalpinia
lc	Ipomoea littoralis Bl.
lc	Synedrella nodiflora
r	Vernonia cinerea
pl	Rhoeo spathacea
pl	Canna hyb.

Broad gravel ridge running parallel to depression is still partly bare but much colonized by fair sized Tournefortia. Scaevola, large loose mats of Lepturus, a few of Triumfetta. Locally abundant seedlings of Euphorbia chamissonis. Two tiny clumps of Allophylus. Some Thuarea, seedlings of Tournefortia + Pandanus Scaevola [illegible]folia.

(to p. 72) In central part, back from lagoon beach, is an open forest, mostly Pisonia 8-10 m. tall, some Artocarpus, some Allophylus, some Pipturus. A great deal of dead brush, obviously chopped Pipturus which must have formed a dense scrub 3-5 m. tall. Sprouts from stubs of this, and from other species also, esp. ~~[illegible]~~ Pisonia and Allophylus, abundant, & 1-1.5 m. tall. This is on small gravel.

Seedling breadfruits to 5 m. tall common.

Oct. 26 - Kinajon I.
Plants seen
l Portulaca oleracea
pl Ocimum sanctum
la Phyllanthus amarus
lc Cyperus javanicus
o Alocasia macrorrhiza
la Euphorbia hirta
c Carica papaya
c Artocarpus altilis
la Lepturus repens
a Cocos nucifera
a Polypodium scolopendria
r Pteris tripartita
la Nephrolepis hirsutula
a Pipturus argenteus
a Vigna marina
pl Xanthosoma sagittifolia
a Wedelia biflora
pl Bougainvillea
c Pandanus tectorius
pl Musa sapientum
lo Cordia subcordata
lc Morinda citrifolia
c Guettarda speciosa
pl ~~Bo~~ Cucurbita
la Cassytha filiformis
o Physalis angulata
lc Triumfetta procumbens
a Fimbristylis cymosa
pl Pseuderanthemum carruthersii
var. atropurpureum
olc Tacca leontopetaloides
r Pilea microphylla

Planted area back of house ~~to~~ dominated by Nephrolepis locally Vigna, Polypodium, becoming overgrown by Wedelia. Some spots still covered by Fimbristylis and/or Lepturus. Farther back toward sea Polypodium and Lepturus are codominant, a little Wedelia. (Photos)

✓ Fairy tern. Common noddy. Many volunteer coconuts. Strip along beach is mixed scrub — Scaevola, Tournefortia, Guettarda, a little Allophylus, tangled in places with Canavalia and Wedelia occasional Cordia. This strip varies, up to 40 m. wide. 2 - 4 m. high.
Two home sites, one at landing on lagoon shore one opposite on seaward side.

Gravel sheet opposite rounded indentation on seaward side — blackened by algae. Colonized by seedlings of Guettarda, Scaevola, Lepturus.

Plants seen (ctd.)

lc Tournefortia argentea
c Allophylus timorensis
l Canavalia microcarpa
la Thuarea involuta
lc Calophyllum inophyllum
r Ochrosia oppositifolia
c Asplenium nidus.
o Pisonia grandis
la Ipomoea tuba
r Nephrolepis acutifolia?
l Hibiscus tiliaceus
l Kalanchoe pinnata
l Barringtonia asiatica
r Terminalia samoensis
a Eleusine indica

Morinda, Pandanus, Triumfetta, Wedelia.
Morinda very abundant in inner part. Some Polypodium.
Ragged but well-recovered Calophyllum trees scattered along top of gravel beach here.

Where shore bulges out, south of bay, there has been some clearing out of brush, resulting in a scattered stand of small ragged trees, tangled dead brush, coconut seedlings.
Intsia seedling on gravel ridge.
South on curve most exposed to sea, is a dense tangled scrub or scrub forest of Allophylus, Guettarda, Calophyllum, Scaevola, an Ochrosia sapling, a little Tournefortia, but dominantly Allophylus. This on beach ridge of gravel. Asplenium nidus common here.
Seedlings of Allophylus abundant, Guettarda less so.

This scrub is apparently left as a wind break on the beach ridge of medium poorly sorted gravel, as it is only a few m. wide. Inside the coconut plantation has been cleared of brush, but is regrowing it.

Large mangrove depression has older trees, to 8 m. tall rather scattered, ~~tall~~ middle layer about 1-2 m. also sparse, lower layer, 0.5 m. mostly dense.

Where brush is cleared in interior Wedelia is growing from stubs, also millions of Wedelia seedlings.

Scrub belt very dense on outer beach ridge changes to Wedelia with
pd bushes of Tournefortia Pipturus, etc. 2 m. high as coast swings round toward south passage beach.

White reef heron. Noddies.

Coconut plantation recently cleared in front here. Many young trees, but probably dating from before typhoon.

This low belt of scrub continues around on beach ridge on passage beach. Here platform of breccia is very well exposed. (photos 6+10)

Inside this beach ridge is a swamp that was almost completely cleared of Bruguiera by the typhoon - is still open except for a few small Bruguiera saplings. Bottom is rather soft mangrove peat with a layer of fine coral gravel on top of it. Enormous mass of rotting debris.

Inside this is a concentric ridge with sparse coconut trees, then another Bruguiera swamp, this one not so damaged in part, part completely cleared.

In outer swamp, about half way from edge to pool in center the peat is 9" deep, with about an inch of mixed sand, gravel and peat on top. Below is gravel.
(samples # 21, 22)

Ridge bet. swamps cleared and staked but not yet planted to coconuts.

Lagoon end of inner swamp open, with only a few living small Bruguiera, old trunks lying all in one direction, to interior of islet.
(photos of this and cleared ridge.)

Lagoonward end of outer swamp half filled by a thick gravel sheet that came in from ~~far~~ seaward quarter of passage beach, ending abruptly, with an irregular steep slope about 1.5 m. high, top very flat. Bottom of swamp here of sharp irregular boulders.

This gravel sheet lines the ~~sa~~ coast, extending well around on passage beach proper, narrowing to a typical boulder ridge. Its top is in part covered by Wedelia, in part by widely spaced Tournefortia bushes about 2-2.5 m. high. Some Scaevola, part open

and blackened.

Several white terns and white-capped noddies.

Inside the second mangrove swamp is a thicket of Hibiscus tiliaceus, then a third more extensive Bruguiera swamp, the taller trees dead, but a thicket of smaller ones, 3-4 m. tall.

Much debris in margin, esp. old Bruguiera poles, all lying one direction more or less southwestward, not quite same as some of coconuts lying in swamp which are more south. Much rough cobble size coral gravel + boulders swept into swamp here from passage beach as edge of thinner gravel sheet, overlying mangrove peat and sinking into it when stepped on. In swamp on a few older trees are a few epiphytic Asplenium nidus, Polypodium scolopendria, and one Nephrolepis acutifolia(?) (too young or at least small, to be sure it is this sp. but probably.).

Around edges of swamp on sloping shore coral gravel, seedling Bruguiera about 3-4 dm. tall abundant. ~~to~~ to high tide mark, but do not look especially healthy. Around edges, above h.t. are patches of Lepturus. Then, extending to lagoon, a blanket of Wedelia at least 1 m. thick, partly cleared inland, with scattered trees, incl. tall Pisonia, lower Allophylus, Guettarda, Pipturus, Pandanus, and coconuts.

p.25 Land staked for planting but not planted.

East of last swamp is another pond, only a few m. across, with 2 or 3 ~~[illegible]~~ Bruguiera, not more than 1-1.9 m tall. Hibiscus tiliaceus tangle on one end.

(insert here part from p 69, put there by mistake)

Boulder + small gravel ridge lying on lobe

of breccia platform on lagoon side, has grove of small Barringtonia (photo, b+w.)

Terminalia samoensis occasional along lagoon gravel ridge.

Weathered spathe of spicate coconut on lagoon beach.

Aedes occasional.

Lagoon shore and back of it toward north far much more sandy than elsewhere.

Oct. 26 - Enmij I.
~~north~~, southward from landing.

Bananas very dense and in good shape, few coconuts.

Then sweet potato area - boulders and coarse gravel piled up to clear sweet potato patches.

Then open gravel sheet, not yet cleared off for planting.

Tall Scaevola, Pipturus, Tournefortia, Wedelia scrub.
Then high ground planted to coconut seedlings, otherwise grassy toward lagoon 2 m. scrub toward sea. This tapers off toward end of islet into Wedelia mat with scattered Pipturus, Tournefortia, Scaevola

This changes to an open scrub of same species, tangled with Wedelia

1 whimbrel [illegible] 1 tattler

Plants seen (ctd.)
Pseuderanthemum carruthersii
var. atropurpureum
Pteris tripartita
Cordia subcordata
Cassytha filiformis
Ochrosia oppositifolia

3 fairy terns on outer reef.

1:26 On outer edge the scrub is very ~~open~~ and about 1 m. high. Some Triumfetta and some Wedelia on ground between Scaevola, Tournefortia and (r.) Guettarda bushes, some open ground. Some Pandanus seedlings. Some patches of Lepturus. This character is maintained for some distance north along seaward beach, but locally the bushes are 2 m. tall

Hernandia, Allophylus, - Pandanus seedling, rare on fresh gravel ridge at top of beach. Also Calophyllum, Scaevola, Vigna.

Some Vigna appears as well as northward.

Then ~~[illegible]~~ reasonably fresh beach-rock at about mid-tide, hardened and the surface abraded, but appears quite fresh. (sample # 23). Sample #24 is sand from the upper ~~to~~ part of beach - a rather thin deposit, for examination as to nature of material. Seaward beach near south end.

North from landing

Bananas around village. Then sweet potato patches, then an open scrub of Pipturus, Pandanus, much Wedelia, some Digitaria patches, Vigna, some Tournefortia and Scaevola.

This gives way abruptly to a grassland of Thuarea, Lepturus and Digitaria with scattered coconuts, all sizes, and tall bushes of Premna, Tournefortia, Pipturus, Allophylus, Pisonia, Terminalia samoensis, clumps of Musa, of Alocasia.

Seaward is a tangle

of Wedelia and shrubs, tapering northward to a beach ridge with Tournefortia.

The grass becomes more and more dominant northward, with few shrubs except young coconut and an occasional Morinda. In places Polypodium almost replaces grass. Fimbristylis and Fleurya common.

Along lagoon beach occasional battered and distorted, (but sprouting abundantly) Cordia trees.

Small colony of Ochrosia on beach ridge at end of islet, with Scaevola, Guettarda, Tournefortia about 4 m. tall, getting lower ~~[illegible]~~ and more open seaward, with seedlings and sprouts of Barringtonia in grassy opening.

Two almost white reef herons in mangrove depression.

Wandering tattlers on both beaches and in mangrove depression.

1960 Marshall Is.

Oct. 27 - Lijeron Islet.

Species observed in 1958:	1960✓
Asplenium nidus	✓
Lepturus repens	
Cocos nucifera	✓
Pisonia grandis	✓
Canavalia microcarpa (?)	✓
Intsia bijuga	
Vigna marina (?)	
Calophyllum inophyllum (?)	
Pemphis acidula	✓
?T Terminalia samoensis	✓
Barringtonia asiatica (?)	
Cordia subcordata	✓
Tournefortia argentea	✓
Guettarda speciosa	
Scaevola	✓
Pandanus (?)	✓

Birds

	Frigate bird	~~50 or 70~~ 100-200? more
nesting	White capped noddy	many
one egg	white tern	fairly common ~~[illegible]~~
	Brown booby	a number
	Bristle-thighed curlew	~~[illegible]~~ ?
	turnstone	medium flock ~~[illegible]~~
	tattlers	one or several
	plovers ?	
	Reef heron	1 speckled

Some of boobies were white beneath, only seen flying, could not see other features.

Jaluit atoll

Islet presents a solidly vegetated appearance low forest with a few coconuts and several other taller trees as emergents. Pemphis patch still presents a weatherbeaten appearance but is generally leafy.

Generally a mass of Pisonia forest with complete canopy at perhaps 8 m. many of sprouts from fallen trees. Some standing trees with tops broken and masses of sprouts, others standing out as emergents.

Around margins Terminalia and Tournefortia are common, forming a zone. One clump of Scaevola 2.5 m. tall in this, a small tangle of Canavalia here, also, with the Scaevola, fruiting. A few standing coconuts many seedlings and young trees. One fallen Cordia with abundant sprouts on beach.

Asplenium common on fallen trunks and ground many many old dead bases. locally forming a ground layer

Humus beds under Pisonia well developed to 5-15 cm thick. Very locally up to 1 cm± of poorly consolidated phosphate rock.

Tournefortia seedling common on n. sandflat.

1 green turtle nest 180 eggs.

Logs and branches are much more rotted than on other islets, possibly from N in guano.

Two long sand horns extending north and south from lagoon corners. Between these active beach erosion is taking place, undercutting the shrubs on shore.

Oct. 27 Second islet north of Mejatto is bare sand with about 2 coconut trees and a few bushes.

From lagoon both ends of Mejatto appear densely vegetated, quite a few coconuts, thick undergrowth. Between, very sparse coconuts, low scrub undergrowth.

Oct. 27 Mejatto, from north end to south.

Plants seen
lo Premna obtusifolia
l Artocarpus altilis
lc Lepturus repens
pl Cucurbita
pl Carica papaya
pl Ipomoea batatas
lc Pandanus tectorius
la Digitaria pruriens v. microbachne
r Portulaca oleracea
pl Mirabilis jalapa
pl Crinum asiaticum
pl Alocasia macrorrhiza
pl Clerodendrum inerme
lc Fleurya ruderalis
pl Plumeria rubra
pl Musa
a Wedelia biflora
cla Fimbristylis cymosa
c Polypodium scolopendria

o Morinda citrifolia
r Nephrolepis hirsutula
la Thuarea involuta
r Tacca leontopetaloides
la Vigna marina
o Eleusine indica
a Scaevola sericea
a Pipturus argenteus
c Guettarda speciosa
r Ochrosia oppositifolia (s)
lc Allophylus timoriensis
r Intsia bijuga (s)
lc Ipomoea tuba
r la Triumfetta procumbens
o Terminalia samoensis
lc Barringtonia asiatica
lc Pisonia grandis
l o Physalis angulata
a Tournefortia argentea
lo Cordia subcordata
lc Cassytha filiformis
lo Canavalia microcarpa
r Centella asiatica
vl Pseuderanthemum car.
carruthersii va. car
~~+ var. atropurpureum~~
lo Calophyllum inophyllum (c
"luguej")
r Pemphis acidula
r Hernandia sonora (s)
r Boerhavia tetrandra
r Euphorbia chamissonis
19 la Bruguiera gymnorhiza
r Nephrolepis acutifolia

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north end of Mejatto large clearing, grassy with Digitaria and some Lepturus and Fimbristylis, scattered coconuts, many breadfruit saplings & seedlings, up to 2.5 m. tall.

This extends perhaps half way to the sea. Then a dense tangled thicket of Pipturus, Scaevola, etc. about 3-4 m. tall, with Wedelia. This with fallen coconut trunks. This extends to near the outer beach, where it thins and becomes lower, becoming open on beach ridge. Here the beach ridge is of cobbles & boulders, perhaps 2.5 m. high.

A few Terminalia seedlings on bare beach ridge. Ipomoea tuba running out onto it.

Extensive rubble tracts on reef flat.

Flock of 6 white terns fishing just outside outer reef. 2 white reef herons. one gray & white one.

Southward from house on lagoon shore the old clearing becomes more and more overgrown with Vigna and Wedelia, and the space between the ~~a~~ scrub belt and lagoon beach narrower.

Then, where islet abruptly narrows down, wide areas are covered by a blanket of Vigna, overlying a sandy gravel flat. This extends along the lagoon coast a bit, changing inland to an open scrub of Pipturus, Tournefortia, etc. tangled with Vigna and Wedelia.

Along lagoon beach and reef flat there are wide, rather thin rubble sheets with a lot of old tree trunks and rubbish.

South of the Vigna area is a flat of gravel with scattered Tournefortia bushes 1-1.5 m. tall, thin Pipturus, thin Vigna, thin Wedelia, presenting a rather arid aspect. Appears

to be an area scoured by typhoon. Inland a coarse gravel sheet with lobed margin, flat, much of it open, scattered Tournefortia and Scaevola about 2 m. tall, ground either bare blackened gravel or thin Wedelia mat, some Triumfetta. Seaward Tournefortia becomes lower, Wedelia denser and thicker, forming a closed vegetation. Becomes open again and irregularly grassy, with Triumfetta, open gravel, Vigna and scattered low Tournefortia and Scaevola in outer 50-75 m. A low bare gravel ridge outside this. Steep gravel beach about 2 m high. Then a rubble tract running perhaps half the length of the island. photos

photos ([illegible])

This rubble tract, uncovered at low tide, has several sandy strips across it, perpendicular to beach.

On the gravel sheet back of the beach ridge about half way to where the open scrub starts is a line of debris - old husks, sticks, coconuts, etc. in which a dense low stripe of vegetation about 1-3 m. wide has developed - mostly Scaevola up to 0.5 m. tall, numerous young coconuts, little taller, Canavalia, Triumfetta, Pandanus seedling Cassytha. Curiously no Tournefortia, though it is abundant, dominant, in the open scrub inland and as numerous as Scaevola (seedling) in the gravel sheet seaward to the gravel ridge.

130 Standing coconuts are very sparse in this section of the islet.

Gravel sheet rather thin here, old coconut root masses occasionally protrude through, covered with Lepturus and Fimbristylis.

A little farther south, at perhaps the narrowest part of the islet the outer portion - gravel sheet, plunge holes, scoured areas, etc has only a sparse mat of Triumfetta and Lepturus, some Vigna, Ipomoea tuba,

Wedelia, etc. with scattered very small Tournefortia about 3-5 dm. tall. Fimbristylis patches very locally.

This thickens lagoonward to a scattered scrub of Tournefortia in a blanket of Wedelia. South of this an area on gravel sheet of tall dense scrub of Lepturus, Tournefortia, & Scaevola, Wedelia, etc. Then a scoured open area of Thuarea, Lepturus, Triumfetta, Polypodium, etc. with scattered shrubs. Southward, again, this thickens to an open scrub and Wedelia blanket.

Outside all of this, the gravel sheet in from the gravel ridge, along all of this, is covered by a sparse scrub of Tournefortia, Scaevola, some young coconuts, etc with patches of Lepturus, Triumfetta, etc.

Gravel ridge bare, white.

Southward this ~~open~~ sparse ~~st~~ scrub strip narrows considerably. the low scrub, with Wedelia or Lepturus extends almost the width of the islet, dominated mostly by Tournefortia, locally Pipturus or Scaevola. Some open gravel spaces. Vigna toward lagoon. Southward much open Thuarea and Lepturus, or Vigna, with scattered Pipturus bushes 2-3 m tall, rounded, and Tournefortia 1-2 m. tall. Inland a large bare gravel sheet of slabby boulders, rather blackened, parts of this with old coconut trunks lying on ground and scattered shrubs. Seaward a narrow strip of thicker lower scrub tangled with Wedelia, then the typical sparse Scaevola Tournefortia about 3-4 dm. tall of the seaward gravel sheet and ridge, some Guettarda and scattered stunted coconut seedlings.

This strip across is about 1/3 the length of the islet, north to south and has almost no standing coconuts, but

some stubs. Just south of it taller and denser scrub, considerable Vigna on seaward side, the open low scrub area very narrow.

Then a badly scoured area across the islet, much open gravel, scattered bushes, some grass (Thuarea + Lepturus) some Wedelia + Triumfetta, scattered Tournefortia, Pipturus, Scaevola shrubs 1-2 m. tall. This extends some distance scrub and open gravel in varying proportions. Thinning out and becoming more desolate in appearance southward, with scattered shrubs mostly about 1 m. tall, of Tournefortia, patches of Lepturus, Wedelia, Vigna, Thuarea, etc., but mostly bare gravel with coconut roots combed lagoonward, old bases, fallen trunks, etc. Many plunge holes. This area shows only the beginnings of recovery.

Bounded southward by a

depression running across the islet with practically no vegetation at all. except along north side a scattering of seedlings of Scaevola and Tournefortia, a very few around, couple of old coconut bases in the middle. Across the seaward side is a gravel ridge. On lagoon reef flat is a pond surrounded by a circular gravel bar.

p 31 1 crested tern on lagoon beach. 2 blue herons lagoon beach 1 white on seaward beach. 2 tattlers on seaward reef flat.

Several enormous dead Calophyllums on lagoon beach - uprooted.

Oct. 27 — [illegible] along seaward beach from north end —

Low open scrub of Scaevola, Tournefortia, Lepturus with mats of Triumfetta, Lepturus, Thuarea, some bare gravel.

Varying greatly ~~to~~ from place to place in both density and height.

4 Turnstones and a plover.

Oct. 27 Ribon I.
Seedlings on gravel bar
Scaevola, Pandanus,
Calophyllum, Guettarda
Barringtonia, Morinda
Cordia, Vigna, Tournefortia

Plants seen
l Cassytha filiformis
a Asplenium nidus
a Wedelia biflora
a Pisonia grandis
c Polypodium scolopendria
lc Cordia subcordata
c Morinda citrifolia
r Vittaria elongata
lc Canavalia microcarpa
lc Tournefortia argentea
r Nephrolepis acutifolia ?
l Fleurya ruderalis
a Scaevola sericea
la Vigna marina
c Guettarda speciosa
r lc Calophyllum inophyllum
a lc Pandanus tectorius
r lc Barringtonia asiatica
lc Cocos nucifera
la Pemphis acidula

1 bristle-thighed curlew.
eggs, also
Flock of 15-20 Black-naped terns around end of gravel bar, one fully grown young one. 2 common noddies, and quite a few ~~#~~ white terns. One almost grown young one in tree.
Aedes troublesome.

Bottom of enclosed pond now about half covered by low Pemphis scrub perhaps 1.5 m. tall. Some new seedlings or sprouts from old roots. A little Lepturus, some bare rock.
Bar surrounding it largely covered by scrub of Scaevola with a little Tournefortia, some Canavalia. This varies from 1 - 2.5 m. tall. A little Terminalia. Vigna around edges

Plants seen (ctd)
lc Lepturus repens
c Terminalia samoensis
r Pemphis argenteum

The west and south sides present a solid mass of vegetation, largely Pisonia, up to 10 m. tall, maximum, mostly 5-6 m., Cordia, Scaevola, Morinda occasional Tournefortia, Guettarda. Tangled with Wedelia and occasional Canavalia.

Interior ~~dom~~ dominated by Guettarda and Pisonia sprouts about 4 m. tall, with an undergrowth of Asplenium nidus 2 m. tall on large root masses. Some of these old root-masses dead, but covered by countless young Asplenium plants. These also numerous on old coconut husks, logs, etc. Asplenium also epiphytic in lower parts of trees, as is Polypodium.

A few Coconut trees in north part of islet.
This part generally is a low irregular scrub mostly Pisonia sprout Scaevola and Guettarda tangled with Wedelia.

Here a small colony of Fleurya on gravel under a Pisonia tree. Wedelia on base of bar.

On base of west bar a tall scrub of Scaevola and Guettarda. distally from this, a mat of Cassytha, with many seedlings of Pandanus, ~~and~~ Calophyllum, & Barringtonia. Distally from this a mat of Vigna.

~~Here~~ On this islet the largest Pandanus is a single stem about 1 m. or less tall, others very small seedlings. Calophyllum, Barringtonia only seen as seedlings.

This islet has become very luxuriantly overgrown up to about 5-6 m. with coconuts and a few Pisonia trees as emergents.

Oct. 28 - Mejatto. north point and passage beach

Well developed Scaevola fringe, up to 3 m. high, along passage beach. Back of this a sheet of coarse gravel with a few scattered bushes of Scaevola & Tournefortia, an old Tournefortia. Scattered mats of Cassytha, Wedelia, a little Triumfetta, very sparse tufted Lepturus, this especially but not exclusively, on sandy patches. Cassytha on Wedelia and Lepturus. Scattered seedlings of Scaevola, Tournefortia. This was formerly a sandy area where coconuts were always yellow, acc. the boys who live here.

Toward sea the Wedelia and Cassytha become abundant and the ground cover complete. This coincides with end of gravel sheet and greater sandiness of ground. Lepturus and Fimbristylis also more abundant, and Fleurya.

Toward seaward corner the Scaevola fringe is interrupted by a wide sheet of coarse gravel, partly bare, partly covered by an irregular Scaevola scrub fading inward to a mixed open scrub with Lepturus and Wedelia. Passage beach lined generally by a low narrow ridge of pebble gravel.

1 white heron
2 turnstone
1 white tern

Middle of Mejatto where I left off yesterday south of big scour an area is being colonized by Scaevola and some Tournefortia. a few stunted yellow coconuts, none of them over 0.5 m. mostly less. sparse. Toward lagoon on remnants of soil is irregular scrub & grass. a few standing coconut trees and many stubs.

Then for a stretch there

is an irregular, very
low scrub, quite sparse.
remnants of soil filled
with coconut roots.
small thin mats
of Tournefortia, patches
of Lepturus, seedlings
of Pandanus + Barringtonia
but main components
Scaevola + Tournefortia.
A few seedlings of Guettarda,
Hibiscus tiliaceus, Morinda,
Wedelia, Pemphis, Calophyllum

Then another deep
scour.
The entire area between
these 2 deep scour channels
has been scoured off except
for remnants of soil
held by coconut roots.
(b-w photos)
The second scour also
has a gravel ridge on
seaward side, not
so complete. No vegetation
except on several areas
of firm soil not entirely
scoured off. Here a sparse
Scaevola, ~~Tou~~ Tournefortia
scrub 0.5 m.± tall.
Southward after is
broken up area of soil
remnants and small

scour channels, with
~~at~~ very irregular
mixed scrub and
grass patches, a taller
mixed scrub of Tournefortia,
Lepturus, Scaevola, etc.
(2 b+w photos)
This very open, with
patches of grass (Lepturus)
and of open gravel sheet.
Bushes rounded. 1-2 m.
tall.
[Lepturus = aruume, acc. Elvis)
(used for cordage.)
Southward, shrubs
more open. Vigna mats
on lagoon side, Thuarea
and Wedelia seaward.

Small mangrove swamp,
sand bottom, with irregular
but pure stand of Bruguiera,
.5-1.5 m. tall. near lagoon,
separated from lagoon by
sand ridge, encroached
upon from seaward by gravel
ridge. No larger Bruguiera
trees, but a few dead skeleton
lying lagoonward, pointing
toward lagoon.
Gravel sheet to seaward,
very sparse scrub, mostly
Lepturus, with grass mats
and ~~[illegible]~~ gravel. Fimbristylis
(photo)

'Plover, 'Turnstone

seedlings locally abundant.

Lepturus & Thuarea more abundant southw on gravel and on sand ridge along lagoon.

Local patches of Euphorbia chamissonis, no obvious reason. Some Triumfetta

Then tall open scrub of Pipturus + Tournefortia with grass, Triumfetta, Wedelia + open gravel patches.

Crested Tern on lagoon side. harsh squawking etc.

Tall scrub becomes lower, 1-1.5 m. tall, open with solid grass. Lepturus + Thuarea, ground layer occasional mats of Wedelia.

Leeward lower, more open, little grass, Triumfetta and Vigna form sparse ground cover. Some Canavalia occasional mats of Cassytha occasional Pemphis + Morinda seedlings.

This scrub, both zones, continues for some distance but gets somewhat lower and sparser, ground cover more irregular, more bare

---

sheet gravel. Seedlings of any kind rather scarce. a few of Pipturus.

One Terminalia bush.

Around old battered but sprouting clump of Barringtonia are abundant Barringtonia seedlings, toward seaward side.

Scrub gets denser again but ground cover less.

Then a badly scoured section little ground cover, but open Tournefortia Pipturus scrub 1-3 m tall. One Tacca plant, one Asplenium nidus, on gravel sheet in openings, a few Guettarda seedlings.

Then an open area with very sparse and irregular scrub 2 m. tall, mostly Tournefortia, with almost complete ground cover of Thuarea, Triumfetta, some Wedelia. The same almost across the islet except for a strip of open small Scaevola just back of seaward beach ridge.

Southward the scrub gets lower, 1-2 m. tall. Triumfetta becomes dominant

in ground cover, with
some Fimbristylis.
Southward scrub
becomes lower and denser,
in places almost closed,
Scaevola more abundant
but with Tournefortia.
Wide gravel sheet seaward
with scattered very small
Scaevola and Tournefortia.
Almost no ground cover
except scattered thin
Triumfetta mats.
Then sparser, taller
Tournefortia scrub
with Thuarea and
Lepturus ground cover.
Some bare gravel sheet.
Some Vigna along lagoon.
Some Triumfetta
and Wedelia inland, also.
Then mixed ground
cover of Thuarea, Triumfetta,
Euphorbia chamissonis,
Fimbristylis, a little
Polypodium, Cassytha—
where ground is sandy
gravel. Triumfetta
locally dominant.

2 plovers + 1 turnstone flying
around together.

On ocean side the
very sparse ~~of~~ low
scrub continues.
Density and height
inland varies. up to
3-4 m. locally, in
places closed, others open
to sparse.
On lagoon side a
small depression, sand
bottom, no mangroves,
no veg. except a couple
of small mats of Lepturus
on sides.
Then southward an
area of grass with
few shrubs, back of
it and southward
tall scrub tangled
with luxuriant Wedelia.
Open scrub with little
ground cover seaward
becoming almost closed
southward, then
somewhat open again,
on very coarse loose
boulder ~~gr~~ + cobble gravel.
Thin ground cover of
Lepturus + Triumfetta,
or none. Coarse substratum
fairly general. Much
Fleurya in open parts
of scrub. Locally
dense scrub and Wedelia.

Scrub thick and tall, 3 m. Tournefortia + Scaevola, with Wedelia, toward lagoon. Then scattered mangrove swamp. with Pemphis around edges. some tall Bruguiera, 6 m. some 1 m. Bruguiera, some open depression with much debris. Southward large area of debris-filled open depression, some of it with dense stand of small Bruguiera saplings. Pemphis irregularly peripheral.

Southward another smaller depression with Bruguiera saplings, some Pemphis, some open ~~[illegible]~~ gravel + debris bottom.

Here surrounded mostly by a very dense tall scrub of mixed composition Pisonia, Allophylus, Pemphis, Scaevola, Wedelia, etc. Extreme end is a gravel flat partly covered by a dense & open low scrub, of

Tournefortia, Pemphis, Scaevola. Tangled with Ipomoea-tuba. Large Pemphis + Guettarda, Allophylus badly beaten by typhoon but sprouting abundantly, choked with Wedelia. in point.

Leeward a dense to open scrub of Scaevola and Tournefortia 1-2 m. tall

Half dozen white terns flying over this area.

The scrub types on this island mostly give the impression of being even-aged stands, regardless of density, and with remarkably few seedlings in openings. Little correlation with substratum, only broad correlation with place on island. Generally sparser and lower toward seaward side.

~~[illegible]~~ 1960 Marshall Is.

1 Oct. 28 – north end of Megatto I.
on open bare gravel sheet from 1958 typhoon

✓ 4 14 14 Fimbristylis cymosa R.Br. common

2✓ 15 Lepturus repens var. subulatus Fosb.
2✓ 16 Lepturus repens var. septentrionalis Fosb.
2✓ 17 Lepturus repens var. septentrionalis Fosb.
✓5✓ 18 Boerhavia tetrandra Forst. rare
2 19 moss
on old rotting coconut husk in scrub back of beach.

Coconut planting on Jaluit atoll in form of a 28' grid over most islets, and generally regardless of soil and terrain – swamps, rocks, gravel, etc., and ~~[illegible]~~ regardless of existence of standing trees. Three foot wide and deep square holes dug – ~~[illegible]~~ vegetable trash thrown in, then hole nearly filled with sand or gravel. Coconuts planted later in these holes, not completely buried.

One rather thorough brushing out done at time holes are dug. Trash allowed

Jaluit Atoll

roots fragrant
– with peppery fragrance.
tufted
(but [illegible] var. subulatus")

prostrate; flowers bright pink

To rot on ground, very little evidence of burning seen. Addition of humus to soil is notable.

In general exposed gravel sheets are dark gray or almost black from algae.

7/6 general notes —

Lizard populations seemed large on most islets visited except Ribon and Lijeron, where only a very few lizards were seen. Most seen generally were the lined skink. Black skinks were seen on Mejurirak and Jaluit, and slender skinks on ~~Jaluit on~~ Kinajong and Mejatto, one each. However, no special effort was made to examine lizard populations.

Rats were seen in abundance on Enybor, all apparently R. exulans. Rats around the radio station on Jabor were a larger rat, but some smaller ones or mice were there, too, judging by reports of Knudsens and from abundant droppings seen.

Cats abundant on Imroj, seen also on Jaluit. A few hogs generally, also chickens. Two dogs on Jabor, said to be several others on atoll.

A pet Micronesian fruit dove on Imroj.

Wedelia leaves rather generally somewhat eaten by noctuid larvae (similar to army worms) but plants by no means defoliated.

Hypolimnas common.

Various ants common.

No striking abundance of insects anywhere. Aedes occasional on all islets, but not abundant. Some Culex on Jabor, not many.

Very few insects came to lights.

Little soft wingless crickets common in Pandanus leaves on Mejatto.

House flies and a smaller similar fly occasional, annoying but not at all abundant.

Large land crab holes prominent on most islets, incl. Lijeron, where the land crabs mix sand with the humus in places much as the shearwaters do on Heron). (these holes are presumably those of land crabs, but maybe coconut crabs or even shearwaters (but a bit small).

Land hermit crabs not specially abundant.

1960 Marshall Is.

Data on breadfruit disease on Pinlap Islet from report by Eric Knudson based on information gathered May 5, 6, 7, 1960.

<table>
<tr><th></th><th>seedless</th><th>seeded</th></tr>
<tr><td>Total trees living</td><td>307</td><td>73</td></tr>
<tr><td>" dead trees</td><td colspan="2">134</td></tr>
<tr><td>" diseased trees</td><td colspan="2">24</td></tr>
<tr><td>Trees died last 3 mo.</td><td>26</td><td>4</td></tr>
<tr><td>Trees diseased last 3 mo.</td><td>10</td><td>0</td></tr>
</table>

Two areas of infection and a third developing – in the latter ~~the~~ a tree is in last stages before leaves drop off and surrounding trees are beginning to turn yellow.

	dead	yellow
site #1	1	4
site #2	2	3
" 3	0	4

Symptoms

Tree becomes progressively chlorotic; approximately four months after symptoms are obvious lvs. fall rapidly (except for half dozen that turn green suddenly and then almost immediately yellow and fall - not personally observed)

and, as no new growth appears, root set, etc. the tree is presumed dead.

Leaves: 1 top leaf - light green, yellowing starting from leaf margin, random spotting (whitish), and occasional "hairline" necrosis along the leaf margin.

2 leaf necrosis more in evidence, leaf tips slightly curled, necrotic spotting, and definite yellowing over-all.

3. increased necrosis and darker yellowing

4 similar to 3 but leaf begin to die rapidly.

Roots: A tree in the final stages before death was completely dug up and pulled down. Tertiary roots immediately underneath the trunk and those roots 5-15 mm in diameter showed the following deformities:

1 Root was twisted, wrinkled, and often constricted.

2 Galls were evident - approximately twice size of root diam.

3 These galls appear to be "stung" (a black dot from which

streaks radiated) The root xylem on either side of the gall usually had a streaked appearance, discolored black.

4 The galls themselves had signs of rot within the tissue. In the galls the xylem remained unaffected but the surrounding tissues were darkly discolored.

5 In stripping the roots black streaks were randomly but consistently found.

6 Where root was constricted the xylem remained relatively unaffected.

Surface roots within 10 ft of the trunk appeared normal. Small holes just to expose the surface roots were dug around several trees to a depth of 1 - 1.5 ft. There was a relationship bet. the degree of yellowing and the occurrence of diseased roots. Also a greater number of roots were found to be abnormal near the path than were found at an equal radius opposite the path.

Trunk: The tree was sawed in three places:

at base, at middle, and near top. The xylem and phloem appeared normal except for a definite black "shadow" ringing, but penetrating the xylem tissues. This discoloration had a fairly definite border in the xylem but in the phloem it slowly faded without any clear limit. This condition was found only in the tree trunk.

Branches appeared normal.

Summary

There appears to be sufficient evidence for a conclusion:

1 The majority of the diseased trees are situated along the path.

2 The disease is spreading most rapidly along the path.

3 The roots nearest the path show malformation before those farther away.

4 Once a tree yellows and dies in a recognized manner those trees nearby tend to display identical symptoms.

5 The time intervals between yellowing and

death, yellowing and subsequent infection of nearby trees, or death and subsequent yellowing of nearby trees, are uniform.

6. The trees show symptoms easily recognized and can be attributed to a common factor.

[this far from report]

The tree that I looked at that was affected was sprouting a bit from base, upper parts dead, but Knudsen says this is not generally the case. Surrounding smaller trees somewhat chlorotic.

When asked if some coconut trees still retaining leaves after typhoon had died later several Marshallese replied in affirmative. Gave different periods of time, from 4 months to two years.

"Laure" – for coconuts.

Neil Morris, agriculturist on Yap, studied this breadfruit disease further.

Oct. 29 – plane trip Jaluit to Majuro – ~~[illegible]~~, ~~Jaluit~~ ~~[illegible]~~ – up and down s.e. reef of Jaluit first

Down Long Islet –
surge channels abundant

On Jaluit – swamps are only in east end.

Up Long Islet
Jabor – photos
Pass – 4 photos
St. channel 3 bifurcations and an "island" reef in 3rd channel.

strip ~~of~~ mile from Enybor – Pemphis about recovered. Beyond this near angle in reef ~~[illegible]~~ many denuded areas scarcely recovered.

p.19

All along the lagoon reef flat bars are a very frequent feature, mostly near the ~~[illegible]~~ lagoon edge, but also many small arcuate ones near shore. Many remnants of consolidated material, also, out in flat in various positions.

Majuro – s.e. corner, lagoon reef flat much wider than seaward one. On north east and north sides

Marshall Is. Majuro

the seaward flat is much wider. Margin of seaward flat on s.e. corner more lobed, that of lagoon reef more scalloped on north side.

Almost no coral patches or pinnacles in east end of Majuro lagoon.

SAMBUCUS
Sambucus, large plant, ~~on~~ in adm. islet. Asked Mackenzie to send me specimen. (sent + received later)

Pluchea Wedelia seems to be generally the most abundant plant. Pluchea odorata has become relatively scarce except along air strip where it is still abundant.

Many ornamentals in administrative town.

1st 19± photos on kod. roll L are aerial shots along north and west reefs of Majuro climbing from 4 to 6 00 ft. (last shot of coral patches in west end.)

Oct. 31 – Kwajalein Islet, Kwajalein Atoll
N 41420 Dentella repens Forst
common in weedy lawn near school building constructi

Jabwot

Oct. 29. Jabwot – flew over very low several times.
Scaevola sericea
Calophyllum inophyllum
Tournefortia argentea
Thuarea involuta ?
Artocarpus altilis (s.l.)
Cocos nucifera
Carica papaya
Guettarda speciosa ?

~~Las~~ Generally planted to coconuts, some large patches of breadfruit (several dead) and some yellow breadfruit trees, some dead Tournefortia back of beach fringe on one side. Fairly broad strip of native vegetation on one side (east?), narrow on others. A large taro pit near ne end, extending almost across island. This apparently has

Cyrtosperma Cyrtosperma but does not look well tended. There are several houses and people.

Took about 13 kodachromes.

Breadfruit groves mostly present a very dense and even level canopy.

prostrate, forming dense mats, flowers white.

Namu

Oct. 29 – Namu atoll
flew by at a little distance
except very near south
end, only one tiny islet
on entire west reef. Many
on east reef, well distributed,
except for a considerable
expanse of reef near north
end that has only 2 tiny
specks of land. The
largest islets are at
the north and south points
and on a loop to the east
in the east reef.
A little surf is breaking
along entire east reef. none
on west reef.

Oct. 29 – Kwajalein
Watched cat playing with
a mouse in front of hotel.

---

p.40 Mr. Boyd, U.S. Weather Bureau,
says that when he left Wake
2 years ago there were 50-100
wild cats in the woods
on Wake; a few rats at that time.

He says also that the various
weather stations, such as Kwaj, Eniwetok
Majuro, Johnston, etc. which have
recently been taken over by the
Weather Bureau now publish
monthly and annual summaries.
Also there is a Pacific summary.

Look up
Crowl, P.A. & Love, E.G.
Seizure of the Gilberts and Marshalls.
1-414, Washington, 1955.

Oct. 30 – Kwajalein – beach
and edge of reef at rather
low tide
17 Turnstones
1 whimbrel
3 plovers

1960 Marshall Is.

Oct. 31 – trip in SAR albatross plane around Kwajalein atoll
left field 8:40

Ebeye – most of trees gone from north end, many coconut trees along lagoon shore of settled part.

Center part of ~~Bigej~~ Bokaer(?) cleared, two ends well wooded. Construction

wooded

Bigej mostly well wooded but the old ramp has no woody vegetation. Thoroughly green with Wedelia or Ipomoea.

Small islet n. of first pass has forest but no coconuts. Also next one, well up reef

Reef flat finely and closely striated transversally. Some Channels more coarsely striated.

Next small islet also has natural scrub, no coconuts. (Also the next (prob. Piarna?) also next.

Next is larger, some coconuts in south half, north half scrubby forest.
Next islet scrub forest.
Next scrub forest with a few coconuts.
Next, tiny one, very few coconuts, scrub.
Next one scrub forest with much Pandanus.
Next scrub.
Next coconuts
Next scrub.
Roi – Namur. scattered coconuts, denser in places. Transverse air strip usable. Much open ground on other old strip, grassy with scattered brush

Next islet west has coconuts. Then another with coconuts. Then a pass with a bare sand bar inside it about ~~[illegible]~~ 500 m. or more.
Then a small densely wooded islet.
Large islet with coconuts.
Then a pass with a good bifurcating channel
4 bifurcations on rt. 3 on left.
(photos but not from good positions – end of roll.)

Small scraps of denuded reef platform west of pass.

Small islet, densely wooded.

Another, Pisonia forest with fringe of coconut along inner beach.

Next, solid forest, wind-sheared on east side.

Shallow pass.

Small wooded islet.

Surf on both sides of reef, less inward.

Larger islet, with considerable coconut plantations.

Cross striations on much of the reef here.

Large islet about 2/3 planted to coconuts, some forest on seaward side, some of plantation extending to sea side. forest ?

Shallow wide gap.

Then reef with small bowl-shaped black gravel bar - possibly consolidated.

Small forested islet.

Islet with irregular forest and a few coconuts.

Then another with about half in coconuts.

Small bar with a dozen coconuts, no other plants

Small islet, inner half open scrub, then belt of coconuts, then narrower outer band in forest.

Many patch reefs.

Then large reef flat area.

Islet with open scrub on east end and lagoon shore, coconuts on outer side. Then 2 small islets with much bare ground & little scrub.

Then larger islet mostly open two patches of coconuts. Small islet outside this with coconuts connected by linear bar. linear

Small islet with open scrub. Linear bar to outside of reef.

Then large westernmost islet, irregularly planted to coconuts, a band of sand with open scrub ground south and west sides. Some forest in center. Ebadon

Reef much broader than islets in this western prolongation. Islets look as though a typhoon had swept them except the end one.

Back from end a number of lines, bar just before lagoon begins. One, at least seems to be beachrock, others scarcely.

On much of northwest reef before west end there seems to be a small development of an algal ridge on the inside. with some surf breaking over it.

back along south reef several strips of reef. shallow have with broad transverse striations.

Islet partly planted to coconuts some forest, some very yellow scrub. Then wide gap with shallow areas and 3 deep but narrow cross channels. This reef, well submerged, is quite complex. but does not seem to have surge channels. Has sandy areas at different depths Then a deep channel with

large V shaped reef inside, each fork bifurcated. Inside of right fork a number of patches not forming a very good pattern. None of this would be awash at lowest tides, probably. Well submerged.
Then a shallower stretch with a patch of surf. Then a narrow deep channel Then more well submerged reef.
Then a rather long islet with loose Pisonia forest and a few patches of coconut trees, some open scrub on s.e.
Then a small islet with open scrub, a few coconuts.
A sand bar with a few coconuts and bushes.
A wooded small islet
A long islet with coconuts and a long spit extending lagoonward along a deep, bifurcated channel,

A coconut planted islet with a long spit extending east along reef.
Another long coconut planted islet. A deep pass with

an islet inside,
very sandy, with
coconut trees.
Then a long coconut
planted islet with
a narrow brushy eastward
extension with a ~~sand~~
pond in it.
13 Then a long islet,
irregularly planted
to coconuts. a partially
drying reef, another islet
w. half W. half in coconuts
E. end wooded and attenuating
to a spit. thru brushy.
Then a very long narrow
islet with a spit westward
a deep pass with three
islets inside it arranged
in a bifurcating
system, inner one esp. [illegible]
sandy. coconut trees.
Then a long islet
the middle west part
planted to coconuts, very
elongate eastern part
in sand, one or two
patches of coconuts, then
almost a gap, then more
spit and an enlargement
with coconut. Then
irregular interrupted
sand flats partly
in scrub. Then a small

islet, wooded with
some coconut.
a shallow pass.
sand bars on reef
no vegetation
Then an islet planted
to coconuts
a deep pass with
a reef with sand bar
inside
Then an islet with
coconuts, narrowing
eastward, low part
brushy.
Scattered bare sand
or gravel bars on reef.
~~to~~ patches of worn down
consolidated platform.
one bar with 2 coconuts
more bars
Some large patch reefs
inside, but no passes
in the very shallow
reef. Elongate [illegible]
bars and much
rough rubble or consolidated
platform.
Then a Large wooded islet
with a hook on inside
~~w.~~ east end, then a
wide pass.
Large islet, densely
planted to coconuts
except for a couple of spots

inside with large trees
and opening
Another islet with
hook on e. end, and
a deep pass
An islet planted to
coconuts, narrowed
eastward to point.
Bars on reef. One with
4 coconut trees.
Small irregular islet
a stabilized bar with
~~a~~ Suriana. complicated
system of cross pass
bars then an islet
with coconut plantation
then a deep channel,
with a wide gap
shallower eastward.
An islet mostly in
coconuts, some Pisonia
forest some scrub. mostly
scrub on east half and
a patch of Pemphis on
east end, with depression
inside vegetated high
gravel or sand ridge
at pass. Wide deep
pass. Then a couple
of reefs with small
bars.
An islet with tall
Pisonia, some coconuts
connected by a narrow brushy

bar with another with
a hook on east end.
A consolidated bar
lagoonward of these two
islets, almost the length of them, wide, separated from them.
44 Then a wide deep
pass and gap with
submerged reefs
Then an unvegetated
partly blackened bar
A couple of large
patches inside with
bars on them, one submerged.
A tiny islet with coconuts
a deep narrow pass.
then an elongate islet,
irregular width planted
to coconuts on wider
parts.
Then a shallow pass.
Then a narrow elongate
islet or bar with
some coconuts, a little scrub
A small bare bar. Then
a shallow pass.
A reef with an elongate
narrow bar, widening
eastward into an islet
with a west pointing hooked
bar on west end in lagoon,
narrows to bar on east.
Shallow pass.
Elongate islet, west part
partly bare, partly ponds.

partly in Pemphis
Eastern part wooded.
Deep pass, bifurcated.
Islet with Pemphis
surrounded pond,
some coconuts.
Then an elongate islet
partly in coconuts,
somewhat beaten up,
eastern end wooded.
Then a rather deep gap.
Then a wide reef
? with new more elongate
very narrow sinuate
bars, interrupted
again.
Then large islet
open, scattered Pandanus
& other trees mostly
a blanket of Wedelia
scattered coconut trees.
Then shallow gap
to Kwajalein ?.
Arnold LCT on reef.
Went on north from
Kwaj. 2 bare islets
on bars, two tiny islets
with scrub
Ebeye - many coconuts
in south part of village
and around C.G. station
none on north half.
? S. & N. Loi open, beaten
up. Some coconuts some

brushy, low forest on
North Loi, elongate and
brushy ~~too~~ northward.
Small brushy islet
stripped beach rock
along reef. Then very
long narrow brushy
islet, attenuate
westward.
Then Nake (?) with
considerable construction
in middle bare section.
Then a large islet,
coconuts in east 1/3,
mostly in low dense
forest.
Then a moderately
deep pass. Then Bigej
Ruined tanks still there
with vegetation around
them, coconuts on w. side.
? Long reef. Projections
of living coral and algae
extending into lagoon.
Next islet in coconuts.
? Islet in pass Kwadak,
mostly forested, a few
coconuts
Eniwetak still dense Pisonia
forest with lots of bird
but e. end toward pass
has a grove of coconuts.
Came well on this point
awash.

45 northward on reef are some curious circular reefs extending from main reef into lagoon, active growth around periphery of these, sand in center.

Flew south to Lib I.
Reef is widest to west.
Pond in n. e. corner. N. w. corner and n. side has considerable forest, Pisonia: with only a few Coconuts.
Forest around pond not Pemphis?
? Patches of Breadfruit in N.E. + S.E. corner

Tournefortia
Scaevola Calophyllum
Pandanus
Artocarpus Bruguiera
Hibiscus til.

Wind grooves on s. side. diagonal to beach.
Surge channels on n. + s. sides, scarcely on west.

The forest around the pond is puzzling - does not look too much like Pemphis, nor Bruguiera, one patch may be Bruguiera, brighter green than rest. Dull green, rather small

righter

Lib

leafed, somewhat tessellate canopy.
The pond is brown, rusty looking.
This island should repay study.

Back to Kwajalein, north along south reef past Baber, Bigej etc.
drying to salt pool ?
Islet bet Baber & Bigej has very considerable Pemphis.
Pemphis

Extensive boulder tracts on reef north of Bigej. Boulders tend to be aligned transverse to reef, accounting for some of striate appearance.
Most of dark patches on this reef are ~~there~~ these boulder or rubble tracts.

North of Kwadak - a huge loosened boulder - a part of a buttress between surge channels, lying ready to be lifted on reef by a storm.

Coarsely striate appearance apparently due to submerged surge channels.

Rubble all along shows a remarkable tendency to transverse ~~alt~~ alignment But fine striation on paler parts of reef flat is apparently not due to this, perhaps to shallow growing sud, as seen at Kwaj by terminal.

Most of forest seen on these islets earlier this morning is Pisonia.

The herbaceous vegetation on the old ramp at Bigej seems to be Wedelia on about the peripheral half or 2/3 ~~a~~ and Ipomoea in center, though hard to be sure.

1:46 A very few scattered patch reefs in lagoon. Lagoon is quite rough today, quite a few white-caps.

Down south reef at low altitude
Little or no alignment of rubble on these reefs, bars very numerous, though Arcuate bars on lagoon reef flats opposite islets are occasional

Pemphis abundant, occasionally showing wind striation.

1960 Hawaiian Is.

Oct. 16 - Honolulu
41421 Crinum bakeri Engl.
cultivated in garden

Oct. 25 - Honolulu
41422 Crinum asiaticum L.
cultivated
~~brought in by~~ (~~[illegible]~~ C. M. Oliveira)

Nov. 4 - Trip by Boeing jet
Honolulu to San Francisco
10:30 a.m. - 6 p.m. 34,000'.

At about 1:30 - 2 p.m. Honolulu time the sea, as such, was practically unseeable - a scattered layer of small clouds ~~[illegible]~~ lay far below, spotting what appeared to be a deep blue sky, slightly duller and richer than the "kodachrome blue" seen in high mountains, but neither surface of sea nor horizon visible. The clouds did not differ in appearance from what they would have looked like in the sky above, except that we looked down on them. A slight faraway haze obscured where the horizon would have been, fading

except that swells were apparent when seen from a sharp angle ~~[illegible]~~ rearward

Oahu

from seeds brought from Utirik in 1956 (Fosberg 36713)
Flowers picked by C. M. Oliveira, earlier, from same infl. as collected dry now.

out both upward and downward. Above the sky was almost a blackish blue - not a night sky, no stars, but simply a sky blue diluted with black, a rather opaque blue, not transparent, lightening to a normal sky blue toward where the horizon should be. Being on the north side of the plane the place of the sun in this color system was not evident. From time to time an invisible turbulence shook the plane, giving a rather eerie effect.

(as near as I can see from the other side, an indirect view through the glass diagonally, the sun is just an intense white light scarcely influencing more than the immediately adjacent blue.

1960 California

Nov. 5 - Niles Canyon - still in fairly undisturbed condition except for railroads and highway in bottom. South wall mostly densely wooded with a low forest of live oaks, Aesculus, Arbutus, etc. Other wall open, grassy with scattered live oaks. Stream in bottom with abundant water plants. Road to Sunol, more open, but scattered live oaks and Quercus lobata. Grass heavily grazed.

Nov. 7 - Sacramento Valley, from air. - The area west of the lower Sacramento River is almost entirely under intensive rice cultivation. The land is in large blocks and the entire area is cut by a system of large sloughs, lined by very narrow gallery woods, usually not much more than a single row of trees, or even only a strip of low scrub. Between these sloughs are a network of ditches. Along the river, itself, there is a narrow to broad

belt of orchard (peaches?), mostly on the east side, still green but showing some change of color toward red. At a junction of several sloughs is a patch of forest or swamp. Some small wooded islets in larger sloughs. The soil, where the fields are ploughed, is almost black.

1960 Virginia

Nov. 28 - Chantilly airport
Large open field, thickly grown with weeds.
Different weed communities apparently representing different times of withdrawal from cultivation - boundaries between them abrupt and straight. One community dominated by Bidens sp. A few scattered Rubus and one Rhus in this. Separated from a grass community by a line of Juniperus 1-2 m. tall, the Bidens spread 1-3 m. beyond this into grass. Bidens apparently annual. In smaller numbers on into the grass.
In the Bidens abundant small burrows into ground - as many as 7 in one sq. m. seen.
In grass a maze of intersecting runways, some burrows. Also some larger burrows with fresh dirt around mouths.
2 or 3 Juniperus seedlings up to 0.6 m. tall in grass. A few scattered small

Fairfax Co

clumps of Andropogon.
Several rows of large Juniperus.
At least 6 or 8 more hawks of at least 2 species flying mostly just over the tops of the weeds and bushes.
Several meadow larks.
2 shrikes.
Remains of mice, etc. occasional in grass.
Raccoon tracks in mud near large puddle.
One large owl just at sunset, also flying low over grass.
One row of oaks with a small patch of saplings nearby.

1961 Virginia

Labels typed

Jan. 22, Tripps Run arm of Lake Barcroft
1.5 mi. s. of Falls Church
edge of deciduous woods, shore of lake.

41423 Betula nigra
3 occasional
2 24 Lyonia ligustrina
occasional
2 25 Vaccinium
occasional
5 26 Alnus serrulata Willd.
common

5 27 Corylus
occasional
2 28 Hammamelis virginiana
occasional

After several days of weather ranging between 25° and 0° F the lake is frozen over with a firm sheet of ice, that bears a grown person's weight very well. There are several long irregular cracks that have frozen together again, after opening. On the surface are patches of ripple marks, also curious series of concentric irregular ring-like ridges, also patches of semi-consolidated snow.

The upper part of this arm of the lake, the drowned

Fairfax Co.

small tree 6 m. tall, with rough bark, winter condition.
shrub 1 m. tall; winter condition.

shrub 1.5 m. tall; winter condition.
many-stemmed shrub 2.5 m. tall, catkins pendent, not yet at anthesis.
shrub 1.5 m. tall, catkins pendent, not yet at anthesis
shrub 1.5 m. tall; winter condition.

mouth of Tripps run, is largely filled with silt and covered by marsh. The lower parts of this are dominated by tussocks of Juncus effusus, the upper and greater parts ~~with~~ by Typha, with clumps of Scirpus eriophorus (vel aff.).

These marshes do not seem nearly as firmly frozen as the open water. The ice here, as well as in muddy places around the edges, seems mushy. Possibly there is a slight elevation in temperature from heat from decomposition of organic matter in the mud.

1961 Washington area.

Feb. 22. A heavily overcast day, damp and locally very foggy.

In Washington, in the afternoon, areas where snow was still lying were observed to be apparently smoking. - white vapor was drifting up from them in great quantities.

In the evening, during considerable driving around the area south of Falls Church and around and southeast of Seven Corners, fog was locally so thick as to make driving almost impossible. - The distribution of the fog was very irregular. It was observed to be much heavier in areas where there was still much snow on the ground. The snow was "giving off" clouds of vapor, and where it was piled up the snow piles looked like smoking volcanoes. The temperature was generally warm,

probably at least in the 40's. Obviously the fog resulted from warm saturated air drifting over the snow and being cooled off, forming clouds, and the irregularity of its distribution resulted from the irregularity of the persisting snow from storms a week or more earlier.

Feb. 26. Great Falls -
The water is so high that only one small patch of rocks is showing. The water is a cafe-au-lait color and smells quite filthy.

1961 Hawaiian Is. Oahu

Mar. 3 – Route from U of H to Wilson Tunnel to Kaneohe & Lanikai.

Delonix regia along Wilder Ave.

Foster Garden. Spathodea on corner.

Large Samanea in Palama. Mango trees. Cycas at Kupahea St.

Kam School on mountain to right. Casuarina forest above it and on ridges to rt. & left of Kalihi St. on way to tunnel.

Center row of Jasminum multiflorum between highways. Below Casuarina on slope scrub largely of Schinus. more Psidium and Eugenia cumini up the valley.

Scattered Acacia koa, abund more abundant up the valley. Patches of planted Eucalyptus, Eugenia jambos, then forest of Melaleuca, Casuarina, etc. just below tunnel.

View of Kaneohe Bay. Fluted cliffs with Pandanus forest at base at left. Gleichenia patches. Banana plantations. Large mango trees. Road lined with banana

plantations down to Kaneohe.

Large mango trees and Spondias ? on rt. before main intersection.

Kokohali - Kailua Rd.

Hills on right with Lantana, Leucaena, guava.

Lowlands on right mixed low forest of Hibiscus tiliaceus, Eugenia cumini, Samanea, guava, Leucaena.

Prosopis forest at base, low, flat-topped, apparently wind-sheared, undergrowth of Schinus, etc.

Mar. 4 - University to Mokuleia.

Wilder av. —

Punahou - Hylocereus hedge

Row of Roystonea

Lunalilo St. bet Ward & Victoria - fine Ficus microphylla (a benjamina) on rt. in yard.

Vineyard at Queen Emma fine groups of palms.

Vineyard & ~~Houghtail~~ Palama on left a Phoenix, prob. hybrid of P. canariensis & dactyl. 2 large Samanea at Houghtailing. to rt. on King, on left several more Phoenix.

1941 Haw. Is. Oahu

Large Ficus bengalensis
on King beyond Kalihi
Moanalua Gardens.
Salt Lake Hill - Kiawe
forest, Leucaena under layer
some Opuntia on left.
Red Hill - mostly Leucaena
scrub, scattered low Prosopis.
Aiea - Cassia ~~fi~~ fistula
and Acalypha hedge on rt.
as road enters town
Several Cassia fistula in town.
Sugar cane fields.
Leucaena with some Prosopis
in waste places around
P.H., but mostly cane.
Waipahu
10544 Schofield Rd. jct.
Sugar cane.
Waianae Mts. ahead to rt.
Lower slopes grassy and
eroded in places, mostly
thin kiawe forest, with
cactus & shrubs & grass.
10548 Barbers Pt. jct.
Sugar.
Then good Prosopis forest, abt 5 mi
with Acacia farnesiana
interesting dry land plants
Sida fallax
Abutilon incanum
Chloris inflata very abundant
on very rocky ground.
Gossypium tomentosum toward
Nanakuli

Bluffs on right with
thin Prosopis much cactus.
In Nanakuli large
Calotropis gigantea (white
form)

Bet. Nanakuli & Waianae
steep bluffs showing
lamination of lava.
ledges with grass, etc.
Waianae - tidal flats
with Batis.
Much denser Prosopis forest.
Cliffs with cactus.

Makaha - native forest
and [illegible] visible at
head of valley.
Kiawe forest on debris & talus
slopes
cactus, pili grass on ledges.
Flats beyond - Kiawe
forest, pastured.
Scrubby - grassy rock slope.

Vitex on sand at top
of beach.
Cane.
Kiawe forest
Makua V.
~~Kiawe~~ Kiawe forest.
Kaena Pt. road. at base
of cliff. Kiawe scrub
& pili

1911 Hawaiian Is.

Strand flat, with Sporobolus.
Lower tuff slopes with Atriplex semibaccata
Sida, Trisachne
Jacquemontia, Chloris inflata
Heteropogon (abundant)
~~small bushes with~~
Euphorbia
Santalum Waltheria
Chenopodium
Boerhavia
Low Leucaena shrubs
also Acacia farnesiana

On sand dunes
Scaevola
Sesbania
Heliotropium
Euphorbia degeneri
Boerhavia diffusa
Atriplex semibaccata
Dactyloctenium
Sporobolus virginicus
Vitex ~~simplex~~ ovata
Jacquemontia
Sida fallax
Ipomoea pes-caprae
Leucaena

Oahu

Toward Mokuleia
Leucaena scrub
Cane fields and
Casuarina wind breaks
Prosopis - open stands with Leucaena scrub.

The slopes around Kaena Point are mostly covered by a Leucaena scrub that is dead in its upper parts, possibly killed by salt spray, but with prostrate branches at the bases of the dead bushes that are living and green. The whole vegetation seems to be in poor condition (because of dryness or salt?).

On the windward side of the point is a great mass of lava boulders piled out over a rough terrace just above high tide. On this are remnant patches of what appear to be beach-rock - bedded lime sand and gravel quite case hardened. If beachrock it is from a previous high sea stand. Probably eolianite or consolidated dune. These remnants occur at various elevations, up to base of present dune (samples)

19[illegible] Hawaiian Is

Mar. 6 - Univ. to Koko Head.

Leucaena scrub on hills to left of road below Univ. far

Beyond Kaimuki - Kapakahi Valley - lower part the valley is filled with coral plain - lower slopes covered by scrubby open Prosopis forest. Coral plain built up, golf course + residence area. Formerly cane field. Double highway with Jasminum multiflorum and Lantana sellowiana in middle. Hibiscus hedges. also Nerium hedges.

Wailupe Valley - some native forest and kukui at head, slopes Prosopis with considerable pili grass. Some Opuntia.

Beyond - a row of Delonix on left. Bougainvillea on bluff at right.

Niu Valley - Kukui very noticeable at head. Slopes on side of scrub (Schinus? or Leucaena?) with scattered Prosopis. Lower slopes Prosopis. Some grass on higher slopes

Hibiscus tiliaceus on right.

Kuliouou V. same as Wailupe + Niu. Ridges badly eroded. Goats?

Oahu

Kuapa Pond - extensive margin of Batis maritima. but being destroyed.

Maunalua Bay shallow reef.

Koko Head - badly eroded Prosopis and Leucaena.

Koko Crater - Prosopis on base, grass, some spots of Schinus near top.

Hanauma - Prosopis on slopes with loose understory of Leucaena.

Prosopis on flat rather dense, no undergrowth - cleared out for picnic ground. Steep slopes around bay with patches of wind-sheared Prosopis, interspersed with patches of grass and erosion scars. ~~[illegible]~~

Walk down path from parking lot.

Weedy veg. of Chloris inflata
Alysicarpus Passiflora foetida, Waltheria Leucaena, Atriplex Tricholaena
Bluffs of bedded tuff
Boerhavia repens
Sida
at base Leucaena thicket

1961 Hawaiian Is.

planted Casuarina Cocos,
Ficus microphylla, Malvaviscus
Polyscias guil. & Plumeria
Canna, around pavillion.
Cynodon lawns

Weeds - Chenopodium murale,
Cenchrus, Eleusine, Chloris
inflata.
Ipomoea indica.
Argemone glauca
Reichardia
Sida sp. - mentia complex,
Sonchus oleraceus
Setaria verticillata
Ocimum
Dactyloctenium
Malva parviflora (on sand)
upright, lvs. pub. above.
consp. tuff beds on it.
Merremia aegyptia
Verbesina (in sand)
Tribulus (in sand)
Batis maritima (top of beach)
Mangrove fruit on beach.
Patch of Thespesia at
base of slopes at end of
beach to right.
Path up through it.
Lipochaeta integrifolia
Sida - (different)
Hibiscus tiliaceus (green fruit)
above -
Ipomoea cairica
Portulaca oleracea

Oahu

Stachys arvensis
Ocimum (anaal.)
Jacquemontia
Lantana
Eragrostis variabilis
Heteropogon contortus

Low scrub of Prosopis, Acacia,
Lantana, Leucaena, Tricholaena,
Passiflora, Reichardia
Waltheria
good patch of Eragrostis
on eroded place.
Gomphia javanica (dwarfed)
serious erosion on left
scar with Eragrostis
Emilia Sonchus Sida
Chrysopogon, Portulaca in crevices
of tuff.

Eroded trail up through
scrub of Acacia farnesiana

Cassia leschenaultiana
Ageratum conyzoides (dwarfed)

Top of ridge - bare, eroded
down to tuff layer surface - (desert)
Panicum fauriei
Chloris Dactyloctenium
Waltheria, ~~Heteropogon~~, Sonchus
Heteropogon, Atriplex,
Reichardia, Lipochaeta
Passiflora, Digitaria,
Fimbristylis cymosa,

1961 ~~[illegible]~~ Hawaiian Is.

windsheared Prosopis on right

Walking along Hanauma slope toward sea end – First a very smooth eroded tuff, then a rubbly tract, then a grooved or gullied slope.

Heliotropium curassavicum

Fimbristylis, Panicum, Reichardia, Dactyloctenium, Leptochloa all in pits.

First small crater

Hanauma slope dense grass – Chloris, some Atriplex, Cynodon. with ~~#~~ Sida, Reichardia, Emilia (Sida is prostrate)

Crater floor surrounded by low windsheared scrub of Prosopis.

Inside this more grass with Commelina benghalensis

In lowest part of crater solid sod of Marsilea but with considerable invasion of Chloris, Setaria + Xanthium a little Reichardia, Momordica, Malva, Echinochloa colonum; ~~[illegible]~~

Phaseolus lathyroides
Emilia javanica
Jacquemontia (violet)
Waltheria, Sonchus
Tricachne, Cynodon,
Passiflora foetida,
Ageratum, Solanum nigrum
Malvastrum

From crater, west – striking silhouettes of wind sheared Prosopis on horizon.

4-5 ft of water, up to edge of Kiawe.

On out toward end of Koko Head, more bare eroded tuff.

Around edges of crater some remnants of ~~B~~ silty soil held by grass, and tangled roots of kiawe – belt about 3 m. from kiawe intact. then 3 m. more eroding.

Schiedea globosa scattered on eroded slopes (typical var.) locally common – seedlings

1961 Hawaiian Is.

Seaward slope also
eroded. Patches of
Prosopis scrub Heteropogon
& Chloris in small ravines
Schiedea less common.
Waltheria, Passiflora.
Sida, Jacquemontia, Atriplex
Emilia, Portulaca oleracea,
Atriplex

Down slope vegetation
disappears. Last straggling
plants are Chloris, Dactyloct.
& Portulaca. Sonchus.
Panicum on small terraces
Wet with spray on
windward up at least
25-30 m.
Spectacular wind erosion
Nama sandwicensis
rare in crevices.

Euph. hirta, Lipochaeta

Hanauma slope
Dry slope, crumbly.
Lipochaeta, Schiedea
Sida, Desmodium triflorum
Panicum Port. oleracea
Boerhavia Waltheria
Dactyloctenium
Euph. hirta, Stachytarpheta
jamaicensis. Jacquemontia
Panicum torridum

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also

On sheltered aspect
Vigna marina, Emilia
and much more of everything
else. Heteropogon abundant.
Boerhavia rare (5 years ago
abundant acc. Lane)
Spectacular wind erosion
in depression running
down opposite crater.

Route back
Crater on left filled
with Prosopis forest.
Along ridge
Asystasia gangetica
Schinus terebinthifolius

slope -
Heteropogon (patchy)
with wind sheared
clumps of Prosopis.

From top - beautiful
view of coral reefs in
Hanauma Bay
of Koko Crater,
of serrate crest of
dry end of Koolau.
Maunalua Bay, fringing reef
Along road
Desmanthus virgatus
Euphorbia prostrata
Crotalaria mucronata

1941 Hawaiian Is.

Road from Hanauma
cut through bedded tuff
Prosopis forest. Scaevola.
Sand flats with
Ipomoea pes-caprae
Heliotropium anomalum

Where road turns in, one
sole Erythrina left on
rt.
Gossypium along fence
on right. Weedy flats
Prosopis forest on slopes
to left. Cliffs above this
have Heteropogon.
Doryopteris decora on
high ledges.
- Abutilon incanum
on left just before
Makapuu pass.
Mixed pili grass
and [illegible] scrub.
Lipochaeta - Scaevola

Stop at base of cliffs
Cliffs with Scaevola,
Schiedea, varying from wide
Sida, Lipochaeta & linear
Panicum torridum thin, dull
Doryopteris decipiens cauline linear
Schiedea seedling
abundant on ledges and
talus.

Oahu

Boerhavia repens
Panicum fauriei
Lipochaeta integrifolia
Argemone glauca on talus (see Lanai)
Many weeds.
incl.
Cucumis dipsaceus
Solanum nigrum

Canavalia galeata var.
with pubescent lvs.
acute small sepals, no
stipels maroon fls. with
green patch and white
radiating lines from at base
of standard.

On down at bath house

Low scrub of Scaevola,
Santalum ellipticum,
Prosopis (very depressed)
✓ Ipomoea indica
✓ I. cairica
✓ Sida
✓ Jacquemontia
✓ Reichardia
✓ Panicum torridum
✓ Dactyloctenium
Lipochaeta integrifolia
✓ Fimbristylis cymosa
✓ Heliotropium anomalum
✓ Euphorbia degeneri
✓ Lycium carolinianum
✓ Cuscuta sandwichiana (see [illegible])

1941 Hawaiian Is. Oahu

Atriplex
Digitaria henryi
Panicum fauriei
Dactyloctenium
Sporobolus virginicus
Tribulus cistoides
Boerhavia repens + Albugo
Ipomoea pes-caprae ssp bras.
Coronopus didymus
Euphorbia prostrata
Anagallis arvensis
Emilia javanica
Stachys arvensis
Tricachne
Verbesina
Merremia aegyptia
Asystasia
on Mauka side low end of [illegible] some Santalum
Cocculus
Sonchus
Cenchrus
Eragrostis amabilis

Mar. 4, 1941 – Lanikai Point, Kailua — 2 m.
41429 Stachys arvensis — weak herb, odorless.
1 low cliff just above beach

Mar. 6, – Koko Head
on bare eroded Tuff
1 30 Panicum — 60 m — prostrate
common locally
1 31 Nama sandwicensis 1 — 70 m — flowers purple
very rare in crevices

1961 Hawaiian Is.

41437 Portulaca oleracea L.
1 occasional
1 33 Digitaria
rare
1 34 Emilia javanica
common
?35

in dry silty & bottom of crater
1 36 Marsilea villosa
abundant

1 37 Euphorbia
common on old roadside

March 5 - flats northwest of Makapuu Head, on windward side
1 38 Cocculus
common among lava rocks

March 7 - Manoa Cliff Trail
1 39 (bamboo)
forming a dense brake

March 9 - Ridge north of Opaeula Gulch, Koolau Mts.
Open wet savanna-like flat.
1 40 Rhynchospora
occasional
1 41 Arthrostemma latifolium D.Don
very common
1 42 Sacciolepis contracta
common on bare cut banks above trail.

Oahu

40 bronze, stems and leaves fleshy.
60
60 dwarfed by unfavorable habitat; flowers reddish.

100 m prostrate, purple.

6 m.

Twining. flowers greenish white.

420 m.

~~[illegible]~~ culms widely spaced, erect, 5-7 cm thick dark green, internodes rather long.

425 m.

erect. petals 4, pink, caducous, about 1 cm. across.

Mar. 7 – Manoa Cliff Trail
entrance to trail
row of Cordyline terminalis on left* Psidium cattleianum and Eugenia jambos near it

Senecio sp. along trail.
Aleurites and Acacia koa overhead.

Thicket of bamboo

Forest* of Psidium cattleianum

Occasional large koa trees.

Large patch of Cordyline, Psidium guajava, Aleurites
Lantana along trail.
Scaevola gaudichaudiana

Trail lined & choked with Setaria and mass of Eupatorium riparium on banks.

Seems to be about on border bet. koa and lehua zones. kukui patches frequent. Much guava forest. Some Gleichenia.

Pauoa Flats Trail from fork –

down hill past several Pinus trees, onto flat covered with planted forest of several species of Ficus, several Eucalyptus Melaleuca, and Lagerstroemia speciosa etc.

Large patch of bamboo. Then guava forest to pass overlooking Nuuanu Valley. Up ridge to left Gouldia terminalis var. coriacea, Pelea clusiaefolia (1 tree), several forms of Metrosideros.

Down the draw toward Pauoa muddy grassland with Jussiaea, Commelina, Setaria, etc. Panicum purpurascens.

On slope opposite a very heterogeneous population of Metrosideros with Wikstroemia oahuensis, Scaevola gaudichaudiana, above it some S. mollis, and formerly at least hybrids between them.

1961 Hawaiian Is.

Mar. 8 - Honolulu to Poamoho
Cane fields. Some Eucalyptus plantings and pineapple fields
Kipapa Gulch
Pineapple fields & eucalyptus
Wahiawa. Araucaria

Gulch beyond pineapple stand - steep sides have some native plants - Osteomeles, Dodonaea, [illegible] ~~[illegible]~~ sericea!, Metrosideros
Mainly guava and Leucaena. Panicum purpurascens. Aleurites.

Opaeula gulch
lower part - Metrosideros Osteomeles, etc.

1100' Hecht place - in an old planting of Eucalyptus and Cupressus macrocarpa.
Road above this through fields with scattered koa & planted grevillea to sharp turn in rd. Then small road up ridge to end. Trail from here on ridge.
Eucalyptus on ridge.
Good koa forest on sides of gulch, kukui in bottom. Some small lehua at starting point in trail.
Psidium cattleianum

Oahu

Osmanthus
Along trail -
some Eucalyptus planted
a Acacia koa
o Pteridium aquilinum
c Psidium cattleianum
c Stachytarpheta dichotoma?
pubescent, slender spikes, oblong-acute lvs, not sharply serrate.
la Melinis minutiflora
o Styphelia tameiameiae
c Lantana camara
c-a Setaria geniculata
la Gleichenia linearis (patches)
o Cassia leschenaultiana
c Metrosideros collina
c Sphenomeris chinensis
c Andropogon virginicus
c Emilia javanica
o Spathoglottis plicata
o Bidens pilosa
o Psidium guajava
lc Chrysopogon aciculatus
lc Axonopus compressus
lc Sacciolepis ~~indica~~ contracta
o Cuphea carthagenensis
c Santalum freycinetianum
o Osmanthus sandwicensis
o Passiflora edulis
o Aleurites moluccana
o Scaevola gaudichaudiana
o (c) Nephrolepis exaltata
o Paspalum orbiculare
o lc Dianella sandwicensis

1961 Hawaiian Is

c Freycinetia arborea
Cibotium
Paspalum conjugatum
l Euphorbia multiformis
Erechtites hieracifolia (purple)
Cordyline terminalis
Rubus rosaefolius
Wikstroemia sp.

Camp.
flat ridge top with
Gleichenia, Lycopodium
cernuum, scattered
Scaevola, Metrosideros, koa.
some grassy spots
with melastome Andropogon
Rhynchospora, Paspalum sp.
Wikstroemia (rare)
Grevillea robusta

flat erosion remnant

return
Machaerina meyenii
Psychotria mariniana
Clermontia kakeana
side trail
Eupatorium riparium
Ageratum conyzoides
Conyza bonariensis

Oahu

route descr —

1200' park car at end of road on asphalt. Bench covered by Panicum purpurascens surrounded by large acacia koa some small Metrosideros + Aleurites (tree with pale leaves opposite car). Walk along ridge through open acacia koa-woodland - some planted Eucalyptus at first. Many weeds along trail. Pteridium Sphenomeris and Gleichenia. On steep slopes acacia koa is generally dominant but with scattered Osmanthus, Psidium cattleianum. Metrosideros and, on right small clumps of Santalum. A bit up the trail Freycinetia appears, twining in trees. Some epiphytic Nephrolepis, but very few epiphytes here. Scaevola gaudichaudiana, Dianella appear. Local patches of Cordyline terminalis, and Euphorbia. In the gulch bottoms and in draws on steep sides patches of Aleurites forest show up pale against the general dull green of the koa and lehua. Bright green splashes are patches of Gleichenia. Locally small tough shrubs of Wikstroemia.

Climb up sharp ridge to small camp.

1400-1500' Above this is an open savanna of Gleichenia and grasses, with abundant scattered Scaevola, some Metrosideros, koa, etc.

Upper small road is through open woodland of koa, some lehua and Scaevola - much Panicum, Andropogon.

Before hairpin turn - cut with weathered pillow basalt.

View of Opaeula Gulch with small Metrosideros wood on near slope. Guava forest and mango trees, etc in bottom, koa on slopes, kukui in draws opposite with

koa on ridges between. Some grassy slopes. ~~and~~ patches of Gleichenia opposite up stream.

Hecht place - part bet. road and reservoir - Flat with planted Grevillea, Cupressus, Acacia déalbata, etc.

900-1100' Slope above reservoir has some guava, many weeds, but also Cocculus, Wikstroemia, Cordyline, Scaevola gaud., Pteridium, Styphelia, considerable Metrosideros. Scattered Cupressus, Grevillea, Psidium cattleyanum. Some eroded slopes. Osmanthus, Osteomeles.

Turn mauka ~~at~~ bet. ~~Waialua~~ Haleiwa super market & small church. or bet. 2 bridges N of Haleiwa Theater

In Aiea - taro patches makai of old road.

1961 Hawaiian Is.

March 9 - Poamoho Trail.

Pineapple fields - then fields with Panicum and scattered acacia koa, many planted Albizzia sp., etc.

Then gulch with some native trees.

A dense stand of planted Melaleuca.

Then lehua forest with considerable admixture of planted Eucalyptus, Albizzia, Melaleuca, etc. Scattered koa locally. Much staghorn. Clidemia hirta common along road, also Pluchea odorata. Metrosideros displays usual variation.

Melaleuca common along road on ridges. Spathoglottis along roadside, with Commelina diffusa, patches of Panicum purpurascens.

On steep banks Gleichenia lin. common, Cladonia, Andropogon, Sphenomeris, lehua seedlings.

Good example of this at turning place at end of rd.

Trail starts through a grove of Acacia koa.

Gleichenia linearis on steep bank on left.

white fl. Rubus rosaefolius at base of bank, also Arthrostemma lf. Jussiaea (pink fls)

Small landslide scar: Gleichenia, Sphenomeris, Nephrolepis exaltata, Machaerina angustifolia and M. meyenii. Scaevola gaudichaudiana.

At the bottom of a small ravine a clump of bananas probably persisting from old Hawaiian times. At upper edge of this a large Cyrtandra cf. cordifolia? and Cibotium ~~menziesii~~ chamissoi. Jussiaea along trail. Immediately on right Freycinetia, Antidesma and Perrottetia. Then a large tree of Bobea elatior with epiphytic Elaphoglossum reticulatum and a somewhat smaller Antidesma. Nice Cibotium below. All within 3 m. of bananas.

10 yds. Then several saplings of Pelea sp. and a number of large Metrosideros with epiphytic Elaph. ret. and Alyxia.

Acacia koa on slope immediately above, and Elaeocarpus bifidus.

About 100 m. a Eugenia sandwicensis on right.

Clidemia [illegible] along trail

Then a small fresh landslide scar. Excellent examples of variation in lehua. Crossing to opposite side of ridge. At crossing a clump of Gahnia beecheyi

15 m. several small Pelea. Then a Myrsine, to left, among small Metrosideros

a few m. farther, on left a small Ilex anomala and a Broussaisia (large shiny serrate lvs.)

Sphenomeris on bank at right and Gleichenia ~~[illegible]~~ glauca.

Immediately on left a Gouldia terminalis, appar. var. coriacea, blue berries.

Then excellent Broussaisia and Antidesma and on right similar and Gahnia.

where trail crosses back to rt side.

Across to left Pouteria sp. large tree coming up out of gulch, sl. bronzed at tips. Psychotria (Straussia) cf. mariniana (white fls.) A large Ilex just beyond to left.

110 m. on rt. Gardenia remyi several m. off trail in Gleichenia clump. Colony of Gouldia terminalis var. coriacea

Then a nice view of gulch on right at curve in trail. Just above on left a small shrub of Pelea clusiaefolia, and just beyond on rt. Pelea cf. pauciflora (Otto sent to Stone)

20 m. on down on left some large Cibotium and a clump of Psidium cattleyanum and Clidemia.

Just beyond, on left, Euphorbia cf. rockii in tangle of Gleichenia, etc. Steep slope below with Gleichenia with Gouldia term. v. coriacea, Pelea sp. ~~Psychotria~~ Bobea elatior, and down 30 m Scaevola mollis.

Beyond this a small landslide scar with Nephrolepis hirsutula.

Andropogon along trail. Then down to right Phyllostegia grandiflora & Broussaisia. Bobea elatior on right, behind it a lehua with Lycopodium phyllanthum on lower trunk.

100 m. down a large glaucous Pouteria.

Then on left Gleichenia glauca. Down below narrow ridge top Psychotria cf. kaduana.

Large koa, below on right an area of typical koa forest.

Just beyond, some Gleichenia and some Elaeocarpus.

Low part of trail – much Psidium catt. Clidemia, etc.

Several hundred yards along just before another Gleichenia slope – Pittosporum cf. [illegible]

On left and Tetraplasandra on right Pittosporum [illegible].

Lycopodium cernuum
Wikstroemia [illegible]?
Scaevola mollis

Under a large mossy leaning tree and around a curve a Bobea tree with Korthalsella platyclada right over trail on rt.

Trees have epiphytic Grammitis, Elaph. etc.

Well beyond this large curve another Gleichenia slope and excellent view of gulch.

Epiphytes abundant Polypodium tamariscinum several Elaph.

Great slopes of Gleichenia with large Bobea trees and koa

Just before enormous koa tree a bush on right of Clermontia persicaefolia.

~~Hymenophyllum~~ Trichomanes baldwinii & Davallia on left under Cibotium at a deep ravine or cut through ridge to left.

– Then a bare cliff with Cladonia, Sphaerocionium, etc.

100 yds. beyond on rt. a hybrid Scaevola mollis x gaud. like gaud. purple fls.

At a sharp left turn, on right Myrsine ~~[illegible]~~ lessertiana in small Gleichenia patch.

Scattered along trail Eupatorium riparium.

On rest at stream Touchardia on left, Pipturus on rt.

Blechnum occidentale on bank on left.

Native bananas in gulch below.

Well along, on left a small ~~open~~ recess with a trunk with spectacular display of Elaphoglossum sp. & Polypodium spectrum.

160 m. on rt. Hesperomannia and a tree with Grammitis and Polypodium hawaiiense. Psilotum sp.

Then is seen, a Dubautia plantaginea over head

Gouldia term. v. term. on rt. and fairly commonly

Well on up trail Peleas become common. Platydesma appears.

Acacia koa remains a prominent component even more common locally than Metrosideros

Broussaisia fairly common

Forest generally at this alt. rather degraded. open and filled with Gleichenia

Hymenophyllaceae on trees.

A great new landslide scar below trail. Beyond this the forest is in better condition, but still not very good. Less koa here. Broussaisia abundant.

Along Trail Paspalum conjugatum Centella. Psidium cattl.

Forest of Eugenia, Metrosideros, Antidesma, Acacia. Gouldia, Perrottetia

At hairpin curve Leptospermum scoparium(?) on ridge.

A little way along on rt. below is a Tetraplasandra (only pinnate lfd. ~~tr~~ tree)

Pelea abundant.

Cheirodendron rare.

Cibotium menziesii & C. splendens(?) side by side on right.

Coprosma longifolia hanging over trail in shady corner.

Some large Cheirodendron on rt.

Across valley to rt. clumps of Pritchardia.

Large new landslide scar.

Then cross over to other side of ridge. Machaerina angustifolia common.

Bidens sp. on cliff.

Leptospermum abundant planted and forming a pure stand locally.

Isachne distichophylla on banks. Cibotium glaucum on left.

Dubautia laxa overhead.

Trail goes up ridge. Veg. dwarfed and scrubby. Eugenia, Psychotria, Pelea 3 sp., Gouldia, Myrsine 2 sp.

Metrosideros, Antidesma

but Leptospermum is
very abundant.
Lyc. cernuum, Gleichenia,

Pass over to rt. side of ridge.
then on top again. Phyllostegia
grandiflora. Dubautia & Bidens.
Then to left side.
Large tree with 2 sp. Hymeno-
phyllum Polypod. tam. Elaph.
retic. abundant mosses &
hepatics Hym. obtusum, & recurvatum
Wikstroemia, Gouldia,
Metrosideros Cheirodendron
Labordea Machaerina ang.
Dubautia laxa Cyanea sp.
Sadleria cyatheoides, Gleich.
glauca, Scaevola mollis,
Coprosma longifolia,
Phyllostegia grand. Cibotium
glaucum, Myrsine
Psychotria, Antidesma
Broussaisia, Freycinetia,
Gleich. linearis
all make up dense 2-3 m
scrub on high slopes.

Eup. rip. clear up here.

Tetraplasandra on left
A ~~few~~ Trematolobelia along
trail

This now seems fairly
good cloud forest.
More Leptospermum
Trematolobelia
Pritchardia next to
trail on left.
Cheirodendron, Wikstroemia
Pritchardia over trail.
Schizaea on vertical bank
Phyllostegia lantanoides also.

Right turn into a ravine
with cloud scrub –
Dubautia arboreum, Labordia,
Metrosideros, Gouldia,
Coprosma, Broussaisia
Sadleria, Bidens, Eugenia,
Pelea, Myrsine.

Bivouac spot.

Summit trail on other
side of ravine.
Turn left. 210 m.
Grassy marsh in
flat bottom of draw.

Scrub very depressed.
Lycopodium serratum
in boggy spots on left.
Sadleria hillebrandii
Much Machaerina.

Gap at head of grassy draw is badly trampled and converted to grass. Centella, Erechtites, etc.

On crest Vaccinium dentatum, Metrosideros, Broussaisia, Wikstroemia, Gouldia, Dubautia, Cheirodendron, Elaeocarpus, Pelea clusiaefolia, Tetraplasandra, Platydesma, Labordia.

Low dense scrub
Down over edge, Pritchardia, Coprosma, Dubautia, Machaerina, Bidens, Metrosideros (rugosa?), Gouldia, Sphenomeris, Phyllostegia grand. & ent. Trematolobelia, Selaginella menziesii, Sadleria cyatheoides & S. hillebrandii. - Pipturus Eupatorium riparium, Hedyotis centranthoides, Labordia, Gouldia st.-johnii, Zanthoxylum.

Panicum, Nertera, Plantago, Lycopodium, Bidens, Sadleria hilleb. on boggy ridge.

1961 Hawaiian Is. Oahu

March 9. – Head of Punaluu Valley – 800 m.
just north of head of Poamoho Trail
on wet windswept crest with
low scrubby vegetation.

41443 Vittaria robusta
5 rare, ~~[illegible]~~ in shelter of bushes, terrestrial

2 44 Eugenia ~~[illegible]~~ koolauensis Deg.
occasional

2 45 Labordia
rare

2 46 Cyanea
rare

3 47 Coprosma longifolia
common

1 48 same

1 ? 49 Broussaisia arguta f. arguta
shrub 1 m. tall

3 50 Eupatorium riparium
~~[illegible]~~ Occasional along trail

3 51 Pipturus albidus (H. & A.) Gray
common

4 52 Vaccinium dentatum Sm.
occasional

March 9. – Poamoho Trail 775 m.
near Koolau crest

1 53 Selliguea robusta
occasional on vertical mossy bank along trail

March 9 – Poamoho Trail, Poamoho–Wahiawa
? 2 54 Lindsaya macraei 600 m.
in Metrosideros forest

2 55 Cladonia
abundant on cut bank

erect, caespitose

shrub 0.6 m. tall, fruit red.

shrub 1 m. tall, flowers yellow.

fleshy stemmed shrub 0.7 m. tall, fruit yellow, fleshy.

shrub [illegible] m. tall; fruit immature; fls. pale green.

same 1.5 m. tall.

flowers pale green with rose purple stigmas.

weak shrub; flowers white.

? shrub 1.5 m. tall; leaves very rugose above, veins red beneath, areoles green and white.

shrub 0.9 m. high, much branched; flowers red with green tips; fruit red.

1951 Hawaiian Is. Oahu

March 10 - Manoa Cliff Trail
(from Round Top Dr. end)
Row of Cordyline terminalis
on left of entrance.
On trail proper - a strangling
fig (Ficus aurea?) on an
Acacia koa overhead.
Some large Acacia koa overhead
and Aleurites moluccana
on right. Trail grown up with
Setaria palmifolia.
About 100 m. from entrance
Freycinetia on rt., Persea
overhead. 2 introduced Elaeocarpus
above on left. Ageratum houstonianum
in trail. Emilia javanica. Ruellia
graecizans. Passiflora edulis.
Stachytarpheta sp.
koa and kukui overhead.
About 100 m. more an extensive
bamboo grove - beyond this
a kukui forest on rt. Lantana
on trail and Rubus rosaefolius.
Bananas on right.
At first bend - some small
~~Cyr~~ Cibotium cham. above on left.
Commelina diffusa on small
flat place. Then guava on rt.
below. strawberry guava on left.
2 Cibotium on rt. Jussiaea in
trail. strawberry guava
becomes abundant 100 m
beyond bend. Gleichenia
lin. on left just before second
bend.

take left fork at this bend.
thru strawberry guava brush.
Stachytarpheta [illegible]. here in the
Grassy slopes - Paspalum orb.
Sacciolepis, Setaria geniculata,
Cassia lesch. Strawberry guava
brush for considerable dist.
with koa, Freycinetia.
This is modified koa forest.
Coming out of strawberry
guava one encounters a
patch of Cordyline,
with several large guavas
above trail and kukui on rt.
From here trail lined
with Eupatorium. Some
guava brush with Cordyline.
Then at a sharp left turn, first
small lehuas, forming
a scrub below and above trail, also Euph.
multiformis and Schinus.
native Bidens.
Open mixed scrubby wood
of lehua + koa. Just beyond
a large koa hanging over
road Bobea elatior on right
and a thicket of Psych. (Straussia)
cf. kaduana. Around a small
bend, under an Aleurites tree
several Cyanea angustifolia
mostly below trail. A little
farther, a slender Coprosma long.
Eragrostis variabilis
begins to appear on bank to left.

50 m. beyond bend Scaevola
gaudichaudiana above trail.
among slender Metrosideros –
these showing variation.
narrow lfd. forms here.
Just beyond this a large
rock outcrop, then Hibiscus
arnottiana below trail
several trees. Beyond this
clump, several bushes of
Coprosma foliosa – neat, compact,
narrow leafed. Selaginella very
common on rocks above trail,
Hibiscus common. Occ.
Spathoglottis.
A little way on an open
koa stand with Freycinetia
ground cover of Setaria palm.
Guava scrub below trail.
Several Bobea elatior below trail
This koa stand continues
for ~~some~~ distance with scattered
lehua, Scaevola, Psychotria,
guava, strawberry guava etc.
Frosty trees below are kukui.
Sharp bend to left – Eragrostis
variabilis on rocks. Bidens, also.
Sphenomeris. Blechnum. Psilotum
~~Large~~ lehua with curled lvs.
below trail Mixed scrub
on steep cliff-like slope.
Some Lycopodium cernuum
in open ~~[illegible]~~ grassy spots.
Around an ~~[illegible]~~ s bend ~~is~~

a bush of Xylosma hillebr.
on right, then a well-formed
tree of Eugenia sandwicensis
Thicker koa forest with
strawberry guava
guava, Lantana & Freycinetia
brush beneath. Gleichenia
up the slope. Scaevola common.
Occasional white fl'd. Lantana
below.
Then, on bend to left
strawberry guava scrub
with koa trees. Lehua below
Scaevola above.
Beyond this, Passiflora edulis
vines in opening of Setaria palm.
View of kukui forest below.
Along s curve to rt & left
open koa forest with large trees
much Freycinetia, Rubus
rosaefolius & Setaria form
ground cover.
After a couple of hundred m.
to right, the trail bends
sharply left. Just before
this a lehua tree leans
over trail with a clump
of epiphytic Nephrolepis and
wisps of Vittaria.
From here mostly
koa, open with Setaria –
Some guava and patch
of kukui below. for 100 m.
then bamboo grove above trail –
then a patch of lehua, with
Scaevola and Psychotria

Then koa again, with, below trail, several Pouteria (coppery young growth) also a small Antidesma plat.

A little way on an unt. melastome & Perrottetia on left. Athyrium proliferum.?

Then large guava trees & Cordyline. Beyond guavas Antidesma tree with Dioscorea bulbifera + small bananas below trail. A few yards on Elaeocarpus bifidus below trail. Then curve to left with patch of lehua, koa + Elaeocarpus. Perrottetia hanging over trail, then guava forest.

Through this, a curve from which upper Manoa can be viewed, and Konahuanui if clear, is Psych. mariniana shrub on right. A bit beyond this a small Gouldia term. var. coriacea on rt. at edge of cliff. Then Diospyros ferrea v. sandw. also on cliff. Open cliff with Cordyline. Mixed scrub above with Dubautia plantaginea. In a small clump of wood is Hibiscus, Perrottetia, koa, Pipturus albidus. Then more Cordyline on cliff. Zingiber zerumbet in trail.

next small clump of woods is Hibiscus & lehua, with Paederia foetida.

Then guava thickets with some native plants - Gouldia, Hedyotis acuminata, Perrottetia, Hibiscus. In first small opening, Charpentiera above trail a few m.

beyond next small opening, Osmanthus sandw. tree on rt. mixed with Citharexylum which looks almost same sterile.

Sharp turn to left then mixed koa, lehua, hibiscus with much guava. Around a curve nice Cyanea angustifolia above trail.

A bit farther, at a small bridge, in a guava thicket some small Pisonia sh.

Then koa with Euphorbia, Hibiscus, Perrottetia, Gouldia, Cordyline, Psychotria, Persea, etc. beneath.

Open slope with Cordyline lehua & other bushes, much Eupatorium. At other end a little Eupatorium adenophorum.

Then guava thicket, some native plants, much Cordyline. Considerable walk thru this, then several small

1961 Hawaiian Is.

banana plants and Touchardia, on left. Fern covered rocks above with Adiantum cun. Selaginella + large hepatic. Embelia hanging over trail.

Wide ravine with Touchardia, bananas, Cordyline, Coix, Colocasia, and Cyrtandra cf. cordifolia Prob. old Hawaiian cultivation.

Guava forest. Then ~~small~~ opening with Freycinetia, Ipomoea alba and Clermontia kakeana, this at base of large leaning koa on rt. Ilex anomala just above on left. Several more Clermontia on rt.

Much Freycinetia in open koa wood, Much Hibiscus. Large Pisonia on ~~small~~ wooded ridge top to left.

From here on more lehua than koa.

Open slope with view of Manoa & mts. kukui patches conspicuous. Arboretum planted forest in valley below.

Brushy cliffs. lehua & hibiscus with both Eupatoriums

Patch of wood with koa, hibiscus, Antidesma,

lehua, Cordyline, Citharexylum, around sharp curve & down (Elepaio). Dead koa on rt. well epiphytic Nephrolepis exaltata. at next small curve Psychotria hexandra bush to rt. Large membranous stipules

Guava-hibiscus forest. Athyrium proliferum patch on left.

Guava - lehua forest.

Down slope into ~~ko~~ lehua and lehua-koa forest, with Ilex anomala, Clermontia, Perrottetia + Gouldia. Citharexylum abundant. Antidesma + Psychotria (Straussia)

Main trail. (Rt. to Pauoa down slope through koa-guava) Take left fork, then immediately another fork - left goes up Tantalus, straight ahead around Tantalus. Take this. Through ~~guava~~ koa forest with ~~koa~~ guava. Pamakani esp. adenophorum. Some lehua changes very soon to almost pure guava.. with ground cover of Commelina diffusa. Occasional patches of Canna. and Coix. Switchbacks. Blechnum occ. on banks. Nephrolepis cf. cordifolia or exaltata

abundant
Boulders & outcrops on left have Trichomanes saxifragoides. Adiantum cir.
Patches of Hedychium (coronarium + flavum). Thelypteris parasitica

Rejoin Pauoa trail.
Polypodium thunbergii & Peperomia reflexa on large rock. also Trich. sax.
Adiantum on mossy rocks on left.
Sudden change - lava to black sand.
Selaginella abundant in black sand.
Kukui forest in again. Then koa:
with lehua, Elaeocarpus, Ilex, Psychotria, Antidesma, [illegible] Freycinetia etc. on one straight stretch of trail. then more guava forest. Persea, etc. planted in it. Large kukuis & various planted trees. Then thickets of coffee.
Stretch of guava forest, then kukui forest with planted Albizzia falcata(?), then kukui in draws, guava on ridges, occ. koa, lehua, kukui in guava forest below to it.
Some areas have [illegible] albidus Lagerstroemia planted, scattered koa.
Eugenia jambos
Views of airport + Pearl Harbor, Barbers Pt. over Pauoa V. Honolulu Harbor
Many exotic trees planted along last part incl. Persea, Cryptomeria, Ficus, Acacia, etc. Hibiscus til. on road.

1 ½ mi. bet.
entrances
much Hib. til. on upper Round Top Dr.
+ great display of exotics.
Roundtop slopes covered by Leucaena scrub.
Black sand quarry on rt. on way up, fine bedded black lapillus tuff or "black sand"